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L.A. Sena and Yu.M. Kagan deal with "Elementary Processes of Determining the Motion of Ions in Gas".
A paper by Ye. Bedereu (Rumania) dealt with "The Role of Resonance--recharging in the Kinetics of Ions".
I.S. Stekol'nikov considered the initial stages of the development of sparks (corona-leader, main channel and the final channel).
B.N. Klyarfel'd gave a survey of the ignition processes of the discharges in highly rarified gases.
The mechanism of the breakdown of a high-vacuum gap was elucidated in a paper by V.L. Granovskiy.
L. Tonks (USA) expounded a theory of the motion of electrons in a magnetic trap (see p 1316 of this journal).
Academician R. Rompe (Eastern Germany) described a number of experiments on non-stationary plasma conducted by himself.
M. Stenbeck (Eastern Germany) gave a generalised theory of plasma. The conference was divided into six sections.
The first section was presided over by L.A. Sena and was

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concerned with the elementary processes in gas discharges. The following papers were read in this section:
Ya.M. Fogel'- "Transformation of Positive Ions Into Negative Ones in Rarified Gases".
Ya. M. Fogel' with V.A. Ankudinov and D.V. Pilipenko - "Capture and Loss of Electrons During the Collision of Fast Atoms of Carbon and Hydrogen with the Molecules of Gases".
N.V. Fedorenko et al. - "Dissociation of Molecular Ions of Hydrogen During Collisions in Gas".
I.P. Flaks and Ye.S. Solov'yev - "Capture Cross-sections of Electrons in Multicharge Ions in Inert Gases".
R.M. Kushnir et al. - "Experimental Investigation of the Resonance Recharging in Certain Single-atom Gases and Metal Vapours".
O.B. Firsov - "Qualitative Investigation of Inelastic Collisions of Atoms".
L.M. Volkova - "Effective Excitation Cross-sections of the Spectral Lines of Potassium and Argon".
I.P. Zapesochnyy and S.M. Kishko "Some Results of the

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Investigation of the Optical Functions of the Excitation Bands of a Negative System".
A.A. Vorob'yev and A.G. Vlasov - "Investigation of the Scattering of the Electrons in a Betatron Chamber".
The second section was presided over by B.N. Klyarfel'd and was devoted to the problems of the electrical breakdown in rarified gases and in high vacuum. The following papers were read in this section:
G.Ye. Makar-Limanov and Yu.A. Metlitskiy - "Electrostatic Control of the Ignition of Glow-discharge Tubes"(see p 1274 of the journal).
S.V. Ptitsyn et al. were concerned with the breakdown in a high-voltage mercury rectifier (see p 1278 of the journal).
L.G. Guseva "Ignition of the Discharge in Non-uniform Fields at low Gas Pressures" (see p 1260 of the journal).
A.S. Soboleva and B.N. Klyarfel'd - "The Discharge Phenomena Between a Point and a Plane at Gas Pressures of 10^{-3} - 1 mm Hg".

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T.B. Fogel'son - "Methods of Reducing the Energy Lost in the Formation of a Breakdown".
L.I. Pivovar and V.I. Gordiyenko - "Microdischarges and pre-breakdown Currents Between Metal Electrodes in High Vacuum".
V.A. Simonov and G.P. Katukov - "Investigation of the Processes of Initiation and Development of a High-voltage Discharge in Vacuum".
E.M. Reykhrudel and G.V. Smirnitskaya - "The Characteristics of Ignition in High-vacuum in Magnetic Fields".
L.V. Tarasova et al. dealt with the transfer of the electrode material during the pre-breakdown stage in vacuum.
N.B. Rozanov et al. - "The Motion of Micro-particles of Substances During Electric Breakdown in Vacuum".
The third section dealt with the problems of electric sparks, corona and their practical applications. It was presided over by I.S. Stekol'nikov. The following papers were read:
V.I. Levitov et al. - "Probe Investigation of the a.c. Corona Fields".

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G.N. Aleksandrov - "Elementary Processes in the Ionisation Zone of Corona-type Conductors at Atmospheric Pressures".
V.A. Burmakin - "Appearance of a Corona Discharge in Hydrogen and Nitrogen"
P.N. Chistyakov et al. - "Some Properties of the Corona Discharge in Hydrogen in a Coaxial, Cylindrical System".
A.S. Soboleva and B.N. Klyarfel'd - "Appearance of Discharge Phenomena Between a Point and a Plane at Gas Pressures of 10^{-3} - 1.0 mm Hg".
Ya.Yu. Reynet et al. - "Methods of Unipolar Ionisation of Air By Means of Aero-ionisers (see p 1335 of the journal).
M.P. Vanyukov et al. - "Time Spectra of the Radiation of a Spark Discharge in Inert Gases" (see p 1284 of the journal).
M.P. Vanyukov and A.A. Mak - "Production of High Temperatures by Means of Spark Discharges".
V.A. Peretyagin - "Influence of the Magnetic Field of the Electric Discharge on the Dividing Surface of Two Media".

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I.S. Stekol'nikov - "New Data From the Study of Long Sparks".
M.I. Sysoyev - "Properties of the Breakdown of Compressed Air in a Comparatively Uniform Field in the Presence of Localised Non-uniformities".
A.A. Vorob'yev et al. - "Pulse and Oscillographic Techniques for the Measurement of the Discharge Lags in Dielectrics" (see p 1257 of the journal).
A paper by B.N. Zolotykh dealt with the problem of the basic theory of the electric erosion (see p 1330 of the journal).
The fourth section was presided over by S.Yu. Luk'yanov and was concerned with the non-stationary and low-frequency discharges. The following papers were read:
I.G. Nekrashevich and A.A. Labud - "The Nature of the Current Interruption During the Electric Explosion of a Metal Wire".
V.A. Simonov - "Propagation of Plasma From Local Pulse Sources".
G.G. Timofeyev et al. - "Observation of an Electro-dynamically Compressed Arc By Means of an Electron-optical

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Converter".
M.S. Ioffe and Ye.Ye. Yushmanov - "Investigation of the Radial Electric Field in an Ion Magnetron".
V.A. Belyayev and M.K. Romanovskiy - "Experiments with an Electron Model of a System with Magnetic Samples".
A.M. Andrianov et al. "Distribution of Magnetic and Electric Fields in Powerful Pulse Discharges".
G.N. Harding (England) - "Spectroscopic Determination of the Plasma Temperature in the "Zeta" Equipment" (see p 1326 of the journal).
The paper by Harding aroused a lot of interest and Academician L.A. Artsimovich expressed the opinion that the electrons and ion temperatures in the "Zeta" should be of the same order; instead, according to Harding, the electron temperature is lower by an order than that of the ions.
A paper by S.Yu. Luk'yanova and V.I. Sinitsyn was devoted to the problem of spectroscopic investigation of heated plasma.

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I.M. Podgornyy and N.G. Koval'skiy - "New Data on X-ray Radiation During Pulse Discharges"
V.A. Khrabrov and M.M. Sulkovskaya dealt with the investigation of the neutron radiation in powerful gas discharges in chambers with conducting walls.
N.A. Borzunov et al. - "Investigation of the Gas Discharge in a Conical Chamber".
S.M. Osovets et al. - "A Turn of Plasma in Transverse Magnetic Field".
I.G. Kesayev "Data on the Division of a Cathode Spot on Mercury in a Low-pressure Arc" (see p 1289 of the journal).
A.E. Robson (England) - "A New Theory of the Cathode Spot" (see p 1295 of the journal).
L.N. Breusova - "Positive Column in a Hydrogen Discharge With Stationary and Pulse Loads".
I.G. Nekrashevich and A.A. Labud - "Current Distribution on the Surface of Electrodes in Electric Pulse Discharges".
L.S. Eyg - "Some Properties of Gas Discharges in Low-voltage in Halogen Counters".

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G.I. Glotova and V.L. Granovskiy - "Comparison of the Initial De-ionisation in the Isotopes of Hydrogen (H and D)".
L.A. Akol'zina communicated some results on the pre-breakdown current pulses at low pressures.
M.Ya. Vasil'yeva and A.A. Zaytsev - "Charge-density oscillation Waves in Cylindrical Plasma".
L. Pekárek of Czechoslovakia communicated some information on the wave-like phenomena in gas-discharge plasma.
B.G. Brezhnev dealt with the problem of the determination of the energy of fast ions in pulse discharges.
B.B. Kadomtsev - "Convection Instability of a Plasma String".
S.I. Braginskiy and V.D. Shafranov - "Theory of a High-temperature Plasma String".
The fifth section was presided over by N.A. Kaptsov and dealt with high-frequency currents in gases. The following papers were read:
V.Ye. Golant - "Formation of Ultra-high Frequency Pulse Discharges in Inert Gases".

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G.I. Pateyuk - "Influence of the Boundary Conditions on the Formation and Maintenance of High-frequency Discharges".
P.S. Bulkin et al. - "Investigation of a Self-maintained Ultra-high Frequency Pulse Discharge and the Process of its Development".
G.N. Zastenker and G.S. Solntsev - "Some Results of the Investigation of the Formation of Low-pressure High-frequency Discharges".
G. Margenau (USA) - "Conductivity of Weakly Ionised Plasma".
A.A. Kuzovnikov - "The Conditions of Transition From High-frequency Corona Discharge at Atmospheric Pressures".
V.Ye. Golant - "The relationship Between the Characteristics of the Ultra-high Frequency Current and the Direct Current in Gas Discharges".
B.B. Lagov'yer analysed the conductivity of the disintegrating plasma in the window of a resonance discharge tube.
S.M. Levitskiy and I.P. Shashurin dealt with the applicability of the probe method to high-frequency

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discharges (see p 1238 of the journal).
The paper by V. Ye. Mitsuk et al. was devoted to the investigation of the ultra-high frequency plasma by means of the Stark effect.
G.S. Solntsev et al. dealt with the problem of electric fields in a high-frequency discharge at low pressures.
Ye. Bedereu of Rumania read a paper entitled "High-frequency Discharges in Methane".
The work of the sixth section was devoted to the problems of plasma and its radiation; the section was presided over by V.A. Fabrikant. The following papers were read:
Yu.M. Kagan - "New techniques in the Probe Methods of Plasma Investigation"
V.I. Drozdov - "Oscillographic Measurements in Plasma".
V.A. Simonov and A.G. Mileshkin - "Investigation of the Movement of Plasma by Means of a Mass Spectrometer of the Transit Time".
A.V. Rubchinskiy - "Application of the Oscillations on a Small Anode to the Measurements of the Vapour or Gas Density" (see p 1311 of the journal).

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A.A. Timofeyev - "Measurement of the Gas Density During the Dynamic Operation of a Discharge" (see p 1306 of the journal). A.V. Nedospasov - The Nature of a Striated Positive Column".
V.I. Perel' and Yu.M. Kagan - "The Theory of Probes for Arbitrary Pressures".
Yu.M. Kagan et al. - "The Positive Column of a Discharge in a Diffusion Regime".
M.V. Konyukov - "Influence of the Processes of the Annihilation of the Negative Ions on Their Concentration in the Column".
M.D. Gabovich and L.L. Pasechnik - "Anomalous Scattering, Excitation of Plasma Oscillations and Plasma Resonance"
Yu.L. Klimantovich - "Energy Lost by Charged Particles for the Excitation of the Oscillations in Plasma (the Langmuir paradox)" and "The Theory of Non-linear Plasma Oscillations".
Ye.G. Martinkov and I.G. Nekrashevich - "Dependence of the Temperature in the Near-electrode Region of a Pulse Discharge on the Material of the Electrodes".

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N.A. Neretina and B.N. Klyarfel'd - "Formation of Light Spots on the Anode of a Gas Discharge (see p 1301 of the journal).
N.A. Matveyeva -"Distribution of Binary Mixtures of Inert Gases in a d.c. Discharge".
V.G. Stepanov and V.F. Zakharchenko - "Some Phenomena in Rarified Plasma".
V.G. Stepanov and V.S. Bezel' - "The Possibility of Obtaining Highly Concentrated Plasmas".
G.V. Smirnitskaya and E.M. Reykhrudel' - "Some Characteristics of the Discharge in an Ion Pump and in a Magnetic Ionisation Vacuum Gauge".
Ye.T. Kucherenko and O.K. Nazarenko - "Properties of a Discharge with Electron Oscillations in a Magnetic Field" (see p 1253 of the journal).
The paper by L.M. Biberman and B.A. Veklenko considered the approximate methods for determining the concentration of atoms at the radiation levels.

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I.I. Sobel'man and L.A. Vaynshteyn read a paper on "A Non-stationary Theory of the Stark Broadening of the Spectral Lines in Plasma".
M.A. Mazing and S.L. Mandel'shtam - "The Broadening and the Shift of Spectral Lines in a Gas-discharge Plasma".
R. Lunt (England) - "The Kinetics of Electron Collisions Leading to the Excitation of the Molecular Hydrogen in a Hydrogen Discharge".
V.N. Kolesnikov et al. - "Some Properties of the Arc Discharge in an Atmosphere of Inert Gases".
A.A. Mak and M.P. Vanyukov - "Production of High Temperatures By Means of Spark Discharges".

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SOV/126-7-6-14/24

AUTHORS: Spivak, G.V., Yurasova, V.Ye., Klenova, A.I. and Vlasova, T.A.

TITLE: On the Exposure of the Structure of Metals by Gas Ion Bombardment

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 7, Nr 6, pp 893-898 (USSR)

ABSTRACT: In order to show the possibilities of revealing the metal structure of a heated material by a cathode sputtering method, the authors investigated several characteristic alloys. Atomizing of the specimens at a definite temperature was carried out in the apparatus for the ionic etching of metals UIT-1 used by Spivak et al.(Ref 3), in which there is a special device for heating the specimen (from 100 to 700°C) and for measuring its temperature. Sheet specimens of an Al-Mg alloy (6% Mg) were submitted to ion bombardment at 500°C. Cathode sputtering (together with selective evaporation which takes place at such a temperature) reveals the grain boundaries of an Al-Mg alloy (6.5% Mg) heated to 500°C. In Fig 1b the surface of this alloy, etched with neon ions at 280°C and in Fig 1a the structure of the same alloy revealed by cathode sputtering at 500°C are shown. From a

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comparison of these photographs it can be seen that at 500°C the grain size of the alloy is considerably coarser and the grain boundaries are finer. Apart from this alloy, etching of specimens of steel YalT was studied with the apparatus UIT-1. In this case, chromium carbides precipitated along the grain boundaries at 500°C. The presence of chromium carbides after chemical etching is only apparent from the holes where the carbides were attacked. By means of ionic etching at 600°C the chromium carbide precipitates along the grain boundaries could be seen in the form of small dark spheres of approximately 1 to 2μ diameter. A photograph of the surface of steel YalT specimens etched at 600°C and subsequently cooled is shown in Fig 2. In Fig 3 ferrite and austenite grains revealed as a result of cathode sputtering of the steel YalT are shown. In Fig 4 the structure of pure aluminium sheet is shown (a - after chemical etching; b - after etching by ion bombardment). The extent to which the metal structure is revealed can be best judged by the depth of etching of the intergranular boundary. Therefore, in order to select the correct

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sputtering treatment, the dependence of the depth of metal grain boundary etching on the parameters of the gas discharge during simultaneous sputtering was studied. The depth of the boundaries was measured by a stereoscopic method. A quartz print was taken from the atomized surface of the specimen and a precise portion of this print was photographed in the electron microscope UEM-100 under an angle of +6 and -6° relative to the optical axis. The stereo-couples obtained (Figs 5a and b) were studied with the precision stereometer SM-3, which gives the volume effect. In order to obtain more reliable results, the atomizing of the grain boundary was studied in neon and in air for several types of technical copper with two different instruments. Ionic etching of the specimens was carried out initially in a glass tube. The investigated specimen was used as the cathode in the tube. During atomizing, the specimen temperature was kept constant by cooling it with water. The dependence of the depth of etching of the grain boundary on the potential difference between the cathode and anode during atomizing in neon was determined. The density of the discharging current

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was kept constant ($j = 10$ mA/cm^2). The results of the measurements carried out are shown by the curve 3 in Fig 6. The dependence of the depth of etching of the grain boundaries on the density of the discharging current was studied on two types of specimens which were cut out from technical copper of somewhat different compositions. The density of the discharging current varied between 5 and 15 mA/cm^2; the potential difference between the electrodes was kept constant at 5 kW. The specimen was atomized for 5 mins. The dependence of the depth of etching of the grain boundaries on the density of the discharging current was found to be linear (Fig 7). From an analysis of the curves obtained for the dependence of the depth of etching of the intergranular metal boundaries on the density of the discharging current and on the potential difference between the electrodes it is possible to arrive at the following conclusions: there is no advantage in raising the potential difference between the cathode and the anode above 8-9 kW to accelerate revealing the metal structure. It is better for the density of the discharging current to be increased. The greatest permissible density of the

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discharging current in cathode sputtering of metals is determined by the intensity of the cooling rate of the specimen. In the case under consideration, in which the atomized specimens were cooled in a mixture of dry ice and alcohol, a current density exceeding 15 mA/cm^2 should not be used. However, at a more intensive cooling rate, greater discharging currents can be used. The best operating conditions for atomizing technical copper are: $j = 10$ mA/cm^2, $u = 9$ kW, $t = 5$ min, $p = 5 \times 10^{-2}$ mm Hg col. There are 7 figures and 7 references, 5 of which are Soviet, 1 English and 1 German.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet imeni M. V. Lomonosova (Moscow State University imeni M.V.Lomonosov)

SUBMITTED: January 25, 1957 (Initially)
November 12, 1957 (After revision)

SOV/48-23-6-8/28

AUTHORS: Spivak, G. V., Lyubchenko, V. I.

TITLE: On the Resolving Power of Immersion Objectives in the Presence of Electric and Magnetic Microfields (O razreshayushchey sposobnosti immersionnogo ob"yektiva pri nalichii elektricheskikh i magnitnykh mikropoley na katode)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 697 - 705 (USSR)

ABSTRACT: In the introduction, short reference is made to papers in which the domains of ferromagnetics and ferroelectrics are investigated, and the structure of electric and magnetic microfields is investigated. The fields behave like microlenses, nodulate the electrons passing through, and make it possible to investigate the microstructure. When emission systems are used for the investigation of emission center distribution on the cathode surface, the microlenses of the cathode produce a "pseudocontrast" in the image of the emission. In the second part of the present paper the influence exercised by the macrolenses upon the contrast range of the microlenses is investigated. The equations of motion of the electrons in the magnetic and electric fields serve as a basis and solutions are found for the position

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coordinates of the electrons. The results obtained are qualitatively given in a table for various combinations of macrolenses. When dealing with the resolving power of immersion objectives without microlenses on the cathode, the paper by Artsimovich (Ref 7) is mentioned among others. In these papers the resolving power of emission systems with larger aperture had been investigated. Moreover, resolving power was investigated in the case of the use of mechanical diaphragms. Much space is given to the treatment of the enlargement of photooptical immersion objectives and to the irising of the electron beam by magnetic fields acting on the cathode. Formula (18) is developed for the resolving power. In the last part of the paper, calculation of the resolving power of immersion objectives according to the method of the "sighting hit" is dealt with. Again, the equations of motion serve as a basis, and if $E_x = H_z = 0$, a formula for the resolving power is obtained. Next, the influence exercised by the electric microfields is investigated, and for the deterioration of resolving power, formula (24) is given. In conclusion, the enlargement of photo-

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optical objectives and irising by magnetic fields is investigated in the same manner. There are 1 table and 22 references, 11 of which are Soviet.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Physics Department of the Moscow State University imeni M. V. Lomonosov)

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AUTHORS: Spivak, G. V., Pryamkova, I. A., Igras, E. SOV/48-23-6-15/28

TITLE: On the Investigation of the Domains of Ferromagnetics and Ferroelectrics by Means of an Electron Mirror (O nablyudenii domenov ferromagnetikov i segnetoelektrikov pri pomoshchi elektronnogo zerkala)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 729-733 (USSR)

ABSTRACT: In the introduction the advantages offered by the electron mirror, as e.g. the fact that here the object is not bombarded with electrons and a considerable resolving power exists, are enumerated. The working methods with electron mirrors have already been dealt with by the authors in papers published at an earlier date (Refs 1, 2), while others investigated the resolving power. The influence exercised by the strong macro-field upon the weak microfields of the surface is dealt with, and reference is made to the aforementioned papers. Further, the mechanism of contrast formation is dealt with in the intro-duction. The second part deals with the investigation of the structure of domains of monocrystals of ferromagnetics in the electron mirror. In this connection, the investigations carried

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out by the authors in 1955 (Ref 1) are mentioned, in which the possibility of obtaining a magnetic contrast was pointed out. An instrument of this construction with axial symmetry is shown by figure 1. To the fact that the electrons move very slowly in the range of reflecting electrodes, the high degree of sensitivity of this method is ascribed, because the electric and magnetic microfields are very weak. Figures 2-5 show examples of micropictures, viz. first ordinary structural pictures compared with electron-optical images of the domains, and further, pictures taken in various magnetic fields are compared. The investigation of the structure of the domain in ferromagnetics is finally dealt with and is supplemented with examples. Finally, further development was investigated and found to be promising. There are 9 figures and 7 references, 3 of which are Soviet.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Physical Department of the Moscow State University imeni M. V. Lomonosov)

SOV/48-23-6-16/28

AUTHORS: Sbitnikova, I. S., Spivak, G. V., Sarayeva, I. M.

TITLE: Electron Microscopy of the Temperature Variations of the Magnetic Microstructure of Ferromagnetics (Elektronnaya mikroskopiya temperaturnykh izmeneniy magnitnoy mikrostruktury ferromagnetikov)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 734 - 737 (USSR)

ABSTRACT: In the introduction, older works (Refs 1,2) by the authors and others are mentioned, in which an electron-optical method is described, by means of which an image of the magnetic microfields is obtained by secondary electrons. Although the microfields have a field strength of about 10^4 Œ, the images are of poor quality. In the present paper experiments, which were carried out for the purpose of developing methods of investigating magnetic microstructure, are described. Particular account is taken of the use of secondary emission microscopes for the investigation of the dynamics of thermal processes. On the basis of results obtained by other investigations (Refs 4,5), the damaging of the object surface by electron steel and the decrease of this damage is discussed. The secondary emission

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microscope used in the investigations dealt with has already been described in detail by another of the authors' paper (Ref 2); it has an anode voltage of not more than 10 kv. Three pictures (Figs 1,2) are given as examples. The structure recorded by means of a metal microscope is compared with its magnetic contrast, and information is obtained concerning the formation of the magnetic contrast. The whole-metal construction of a secondary emission microscope, which was worked out for the purpose of avoiding the occurring aberration, is then described. By means of this instrument the authors investigated the influence exercised by temperature upon the magnetic microstructure. Experiments carried out with cobalt monocrystals show a sudden change of the domains with temperature. The additional device constructed for the purpose of heating the object is briefly described, and, finally three pictures (Fig 4) are shown as examples of structural domain changes at various temperatures. There are 4 figures and 8 references, 5 of which are Soviet.

Physics Faculty, Moscow State Univ.

SOV/48-23-6-18/28

AUTHORS: Krokhina, A. I., Spivak, G. V.

TITLE: Investigation of the Structural Changes of Dielectrics Which Are Under the Influence of Temperature, Chemical Attack, and an Ionic Bombardment (Izucheniye strukturnykh izmeneniy dielektrikov, podvergnutykh vozdeystviyu temperatury, khimicheskogo travleniya i ionnoy bombardirovki)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 741 - 743 (USSR)

ABSTRACT: The authors first refer to previous papers by themselves (Refs 1,2), in which they showed that by the bombardment of dielectrics with ions attack figures are produced. These figures show the ionic structure of the crystal. The structure of these figures is similar to that after a chemical attack. In the present investigation, the crystals of a number of dielectrics with different orientation of the crystal axis were prepared. The investigated crystal planes of the various crystals are then given, and the structures obtained in this way (Figs 1-6) are shown by six figures. The method described has certain disadvantages because the focusing of the microlenses depends upon the discharge current and the air pressure in the tube,

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and further because the discharge current in dielectrics can be accomplished by the use of metal contact nets.

In order to inhibit the influence of temperature and the variation of ion-current density on the dielectric, tubes with intense water cooling were used. In order to eliminate the disadvantage of the metallic nets, a new method was developed, by means of which the dielectric is heated to such temperatures at which it is in a semiconductor state. By means of the instrument UIT-1 rock salt was treated for 3 hours at a temperature of 400°C, an accelerating voltage of 3 kv, a current of 3 ma, after which it was investigated by means of an electronic microscope. Figure 3 shows the result obtained. By means of this method, the influence exercised by the evaporation of the dielectric and the critical temperature for the intense evaporation of the dielectric were investigated. The result obtained shows that the structure formed by evaporation of the dielectric is identical with those obtained by applying the two other methods. There are 6 figures and 5 Soviet references.

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Physics Faculty, Moscow State U.

AUTHORS: Yurasova, V. Ye., Spivak, G. V., Kushnir, F. F. SOV/48-23-6-19/28

TITLE: Methods for the Development of the Structure of Metals and Alloys by Ion-bombardment (Metodika vyyavleniya struktury metallov i splavov ionnoy bombardirovkoy)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 744 - 749 (USSR)

ABSTRACT: In the first part of the present paper ion-etching of the granular boundaries and of the structural composition of the alloys are investigated within a large temperature interval. First, the advantages of cathodic spraying as against chemical etching and thermal evaporation in a vacuum are pointed out. One of the most important advantages is the possibility of carrying out structural investigations within a large temperature interval. For visual investigation and for photographing a special attachment was constructed (Fig 1). Seven pictures are then shown of aluminum bronze (Figs 2,3), which were taken after various forms of thermal treatment by ion-spraying and cathodic spraying and 350-fold enlargement. The first series of pictures

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distinctly show the formation of the martensite structure in the three ranges of temperature , whereas the second series shows the structural grains at various temperatures. In the second part of the paper the destruction of the surface of the structural grains of polycrystals or of monocrystals by ion-bombardment is investigated. First, the fact is pointed out that by the investigation of the symmetric indentations our knowledge of the mechanism of cathode-spraying has been extended, and that new possibilities of applying ion bombardment may now be found. It follows from the pictures (Fig 5) that the symmetry of orientated indentations agrees with the orientation of the surface of a monocrystal. In the following, the influence exercised by the increase of ion energy is investigated and explained on the basis of figure 5. The results obtained make it possible to assume that the orientated indentations may form in the course of ion-etching. There are 6 figures and 7 references, 5 of which are Soviet.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universitet im. M. V. Lomonosova (Physics Department of Moscow State University imeni M. V. Lomonosov)

AUTHORS: Dubinina, Ye. M., Spivak, G. V., Pryamkova, I. A. SOV/48-23-6-23/28

TITLE: The Obtaining of Images in the Pulse Principle in the Emission Microscope With High Resolving Power (O poluchenii izobrazheniy v impul'snom rezhime v emissionnom mikroskope vysokogo razresheniya)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 6, pp 762-764 (USSR)

ABSTRACT: In the introduction to this paper it is shown that by investigating pulsed emission in an emission microscope, it is possible to investigate the conditions on active cathodes in pulsed operation. Images of the emitting cathode in normal operation are compared with those in pulsed operation. The impulse increase exercises considerable influence upon resolving power. The work described was carried out by means of the industrial electrostatic microscope ESM-50, which has an immersion object with 150-fold enlargement. The block scheme of the current supply of the instrument is shown (Fig 1) and discussed. As examples, two pictures (Fig 2) of the cathode in steady and in pulsed operation are shown; the pictures were

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not found to differ. A further investigation carried out on an L-cathode also showed no essential differences. Finally, the possibility of using pulsed operation when investigating the domain structure in ferromagnetics and ferroelectrics is shown and a stroboscopic arrangement is described by means of which images of the domain structure with higher resolving power were attained. There are 3 figures and 3 Soviet references.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universitet im. M. V. Lomonosova (Physics Department of Moscow State University imeni M. V. Lomonosov)

PHASE I BOOK EXPLOITATION SOV/4337

Spetsial'nyy fizicheskiy praktikum, tom. 1: Radiofizika i elektronika (Special Practicum on Physics, Vol. 1: Radio Physics and Electronics) [Moscow] Izd-vo Moskovskogo univ., 1960. 600 p. Errata slip inserted. 10,000 copies printed.

Compiler and Ed.: G.V. Spivak, Member of the Faculty of the Physics Division of Moscow University; Ed.: (Inside book): I.A. Nosyreva; Tech. Ed.: G.I. Georgiyeva.

PURPOSE: This book is intended for university students in physics.

COVERAGE: This is the first volume of a multivolumed work in physics approved by the Ministry of Specialized Higher and Secondary Education as a textbook at the university level. Volume I presents a description of laboratory tests in radiophysics and electronics. The volume is divided into 2 parts. Part I reviews oscillatory systems, radio wave propagation and acoustics; the second part contains problems relating to h-f electronics and physics. The authors of the work are faculty members of the Radio Physics Section of the Physics Department of Moscow University. Chapter I of Part I was written by

Card 1/8

PHASE I BOOK EXPLOITATION SOV/4705

Radiofizicheskaya elektronika (Radiophysical Electronics)[Moscow]Izd-vo Mosk. univ., 1960. 561 p. Errata slip inserted. 15,000 copies printed.

Ed.: N. A. Kaptsov, Professor; Tech. Ed.: M. S. Yermakov.

PURPOSE: This book has been approved by the Ministry of Higher and Secondary Special Education, USSR, as a textbook for schools of higher education. It can be also used by scientific personnel working in the fields of radio engineering and electronics.

COVERAGE: The book presents problems of vacuum, cathode, semiconductor, and gas electronics, on which is based the operation of vacuum-tube and gas-filled devices, including microwave devices and also apparatus and instruments used in electron optics. It is assumed that the readers of this book havea preliminary preparation in the fundamentals of nuclear physics, quantum mechanics, statistical physics and electrodynamics. The book was written by a group of lecturers of the Physics Division of Moscow State University.

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Radiophysical Electronics

Chapters I, II, and III were written by Professor N. A. Kaptsov; Ch. IV. by Professor S. D. Gvozdover and Docent V. M. Lopukhin; Ch. V. by Professor G. V. Spivak and Assistant Ye. M. Dubinina; Ch. VII. by Docent A. A. Zaytsev and Professor N. A. Kaptsov; Ch. VIII. by Professor N. A. Kaptsov and Assistant G. S. Solntsev. The authors thank Professor S. Yu. Luk'yanov and Docent M.D. Karasev , who reviewed the book. There are 76 references: 68 Soviet (including 14 translations), 6 English, and 2 German.

TABLE OF CONTENTS:

Radiophysical Electronics

Card ~~6/10~~

S/058/61/000/012/060/083
A058/A101

AUTHORS: Sbitnikova, I.C., Spivak, G.V., Sarayeva, I.M.

TITLE: Temperature variations of the magnetic microstructure of ferromagnetics detected by means of secondary electron emission

PERIODICAL: Referativnyy zhurnal. Fizika, no. 12, 1961, 384, abstract 12E694 (V sb. "Magnitn. struktura ferromagnetikov", Novosibirsk, Sib. otd. AN SSSR, 1960, 41 - 46)

TEXT: Using the technique worked out earlier (RZhFiz, 1954, no. 9, 10419; 1956, no. 10, 29163; 1957, no. 12, 30558), magnetic microfields set up by martensitic needles in a steel specimen were observed in a secondary-emission electron microscope. Weakening of these fields with increasing temperature was observed. A change in and weakening of domain-scattering fields on the hexagonal surface of a Co single crystal incident to heating to 240°C was also observed.

N. Serov

[Abstracter's note: Complete translation]

Card 1/1

S/058/61/000/012/055/083
A058/A101

AUTHORS: Spivak, G.V., Pryamkova, I.A.

TITLE: Development of an electron-mirror method for visualizing domain structure is ferromagnetics

PERIODICAL: Referativnyy zhurnal. Fizika, no. 12, 1961, 383, abstract 12E685 (V sb. "Magnitn. struktura ferromagnetikov", Novosibirsk, Sib. otd. AN SSSR, 1960, 185 - 189)

TEXT: There is described a glass model of a direct electron mirror in which in contrast to earlier models (RZhFiz, 1956, no. 9, 25867) - the reflected and the primary electron beams are not specially separated. The primary beam passes through an aperture in the screen, approaches the investigated object, is reflected and, after being focused, hits the screen. This makes it possible to increase the magnification and sensitivity of the instrument. With the aid of the described electron mirror there were observed domain structures in different ferromagnetics. A metallic model of the direct electron mirror with electron-optical magnification $\sim$250 is also described. Problems are discussed concerning formation of images of domain microfields in the mirror.

[Abstracter's note: Complete translation] N. Sedov

Card 1/1

S/058/61/000/012/054/083
A058/A101

AUTHORS: Spivak, G.V., Shishkina, Ye.I., Yurasova, V.Ye.

TITLE: Concerning a method for detecting magnetic inhomogeneities

PERIODICAL: Referativnyy zhurnal. Fizika, no. 12, 1961, 383, abstract 12E684 (V sb. "Magnitn. struktura ferromagnetikov", Novosibirsk, Sib. otd. AN SSSR, 1960, 191 - 194)

TEXT: The feasibility was demonstrated of detecting magnetic inhomogeneities on the surfaces of ferromagnetics by means of chemical etching. The indicated method is based on the fact that ions in solution that have a magnetic moment are drawn into the region with the highest magnetic-field gradient. The most effective etchants and etching conditions were found by the trial-and-error method. Using the described method, an electron-microscope image was obtained of magnetic inhomogeneities in an artificial specimen built up of alternate Permendure and Mo bands, as well as an image of natural magnetic inhomogeneities in martensitic needles in steel.

N. Sedov

[Abstracter's note: Complete translation]

Card 1/1

Spivak, G.V.

S/109/60/005/05/020/021
E140/E435

AUTHORS: Basalayeva, N.Ya., Vikhlyayeva, R.P., Zhdan, A.G., Zernov, D.V., Kofanova, T.I., Petrova, I.Ya., Potilova, N.M., Polyakova, M.A., Popov, B.N., Spivak, G.V., Shabel'nikova, A.E. and Yasnopol'skaya, A.A.

TITLE: Report on the Ninth All-Union Conference on Cathode Electronics

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol 5, Nr 5, pp 866-879 (USSR)

ABSTRACT: This conference took place in Moscow from 21-28th October 1959 with the participation of Soviet scientists and guests from Hungary, Eastern Germany, the Chinese Peoples' Republic and Czechoslovakia. The chairman of the organization committee was Academician Vekshinskiy. The report consists of brief abstracts of 125 papers presented at the plenary sessions and the sections of the conference. 15 Reports were presented in the section on surface properties of solids dealing with electron adsorption and structural properties of active surface films. Electron-optical studies of "patch fields" on emitting surfaces were discussed. 6 Papers on the

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physics of semiconductor cathodes were given in the section on thermionic emission. 17 Papers were presented in the section on photoelectric emission. Many papers discussed industrial technology of photocells and multipliers. 16 Papers were presented at the section on secondary-electron emission. The section on field emission heard 11 papers discussing pulse field emission at high current densities, surface phenomena, field emission of semiconductors and the "condenser" cathode. More than 30 papers and brief communications were presented at the section on properties, new types and technology of cathodes, relating to the technology of various types of cathodes, their behaviour in practical devices and the operating mechanisms of individual cathodes. 19 Papers were given at the section on interaction of solid bodies with streams of charged particles and residual gases. Notes of conference discussion indicated that several sharp and critical exchanges of views took place.

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S/109/60/005/008/023/024
E192/E382

9,3120 (1043, 1137, 1140)

AUTHORS: Sirotenko, I.G., Spivak, G.V. and Groman, A.

TITLE: Field Emission from Filamentary Semiconductor Monocrystals or Whiskers

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol. 5, No. 8, pp. 1348 - 1350

TEXT: The work reported deals with the manufacture of semiconductor whiskers and measurement of their field emission. It appears that the data relating to the field emission of such monocrystals are lacking (Refs. 7, 8). The whiskers of tungsten and molybdenum oxides obtained by the authors are larger than the usual micro-whiskers. The whiskers are produced by the following technique. A small quantity of tungsten or molybdenum oxide was placed in a quartz tube having a length of 15 cm and a diameter of 6 mm, the tube being closed at one end. The oxides were obtained by burning fine wires in an oxygen atmosphere. By heating the lower end of the tube in air a sublimation of the oxides was achieved and the vapours condensed on the comparatively cold portions

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S/109/60/005/008/023/024
E192/E382

Field Emission from Filamentary Semiconductor Monocrystals or Whiskers

of the tube (see Fig. 1). A growth of whiskers occurred at various areas of the tube, depending on the concentration of the vapours and the temperature gradients. At very high vapour concentrations the whiskers were in the form of dendrites. In order to obtain the whiskers in a suitable form, a metal loop was introduced into the quartz tube and the whiskers were grown on it (Fig. 1). After that the wire loop was suitably mounted in a gun and investigated. In the case of molybdenum oxide, the whiskers were also obtained by the following method: a spiral having a diameter of 5 mm and a length of 5 cm was made of molybdenum wire and one of its ends was bent in the shape of a loop; this was then placed inside the spiral so that the end of the loop was roughly in the centre of the spiral; when the end of the spiral was heated by an oxygen flame the molybdenum was oxidised and the resulting oxide vapours were condensed on the loop in the form of whiskers. The whiskers were investigated

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Spivak, G. V.

82158
S/048/60/024/06/03/017
B019/B067

9.3120

AUTHORS: Spivak, G. V., Pryamkova, I. A., Sedov, N. N.

TITLE: On the Formation of the Electron Optical Contrast in the Observation of "Hollow Spots" in Emitters

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1960, Vol. 24, No. 6, pp. 640-646

TEXT: This is the reproduction of a lecture delivered at the 9th All-Union Conference on Cathode Electronics from October 21 to 28, 1959 in Moscow. Contrast problems of emission and of quasi-emission (mirror-type) electron optical systems were investigated. In the first chapter, the authors describe the influence exercised by the normal and the tangential component of the electric field on electron kinetics, and in the second chapter they deal with the mechanism of formation of the contrast. The formation of "hollow spots" due to local potential differences of the reflecting electrode is explained, and the fact that the microfields of these electrodes can be investigated at any temperature is shown to be the most important property of this type of electrodes. The influence

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On the Formation of the Electron Optical Contrast in the Observation of "Hollow Spots" in Emitters

exercised by "hollow spots" on the resolving power of an immersion objective is briefly dealt with, and in the following the local microfields on emitting surfaces are discussed in detail. Here, "hollow spots" observed by the authors on polished, well activated diodes consisting of copper-aluminum-magnesium alloys and on rather smooth L-cathodes (Ref. 1) are described. By comparing the secondary electron emission images and the thermionic emission images the authors observed that the former are caused by the roughness, and the latter by the inhomogeneities of the work function, i.e., by the "hollow spots". The formation of the contrast in oxide cathodes was investigated in detail where the formation of the mirror image, the thermal image, and the photoemission image were studied. For this purpose, the combined electron microscope shown in Fig. 4 was used. It was found that the geometrical relief of the cathode surface, the "hollow spots" and the electric microfields play an important part in the formation of contrast. In the final chapter, some typical cases of the formation and the inversion of the contrast by superposition of microfields are discussed. There are 5 figures and 10 Soviet references.

Card 2/3 Physics Faculty, Moscow State U.

SPIVAK, G.V.

82164
S/048/60/024/06/09/017
B019/B067

9.4300

AUTHORS: Sirotenko, I. G., Spivak, G. V.

TITLE: Pickling Demolition of Semiconductors by Ion Bombardment

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1960, Vol. 24, No. 6, pp. 679-684

TEXT: This is the reproduction of a lecture delivered at the 9th All-Union Conference on Cathode Electronics from October 21 to 28, 1959 in Moscow. Cathode sputtering of semiconductor crystals and monocrystals is investigated (germanium, silicon, ferrites). The aim of the present paper was to extend the pickling by ion bombardment to a larger number of semiconductors, to get to know the type of sputtering for semiconductors, and to develop the pickling demolition of the semiconductor surface as they occur in electronic devices and disturb operation. The initial cathode sputtering of semiconductor for the ion-pickling by the glow discharges in two-electrode tubes filled with rare gases showed poor results. Better results were obtained by treating the targets in plasmas with high current density and low pressure. The pickled germanium crystal surfaces shown

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82167
S/048/60/024/06/12/017
B019/B067

9,4300

AUTHORS: Krokhina, A. I., Spivak, G. V.

TITLE: On the Problem of Anisotropy of Cathode Sputtering of Dielectrics

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1960, Vol. 24, No. 6, pp. 694-697

TEXT: This is the reproduction of a lecture delivered at the 9th All-Union Conference on Cathode Electronics from October 21 to 28, 1959 in Moscow. In the introduction, some papers on the destruction of metal surfaces, dielectrics, and semiconductors by incident ions are discussed, and V. Ye. Yurasov (Refs. 1, 7) is mentioned. In the present paper, experimental results are given which show that an anisotropy of cathode sputtering in the bombardment of dielectrics with ions occurs, which is caused by the structure of the ion beam. First the authors describe the test tube shown in Fig. 1, and the target holder shown in Fig. 2. Figs. 3 and 4 show distributions of deposits on NaCl and KBr crystals which are due to the inhomogeneities of the incident ion beam. The authors are of the

Card 1/2

SIROTENKO, I.G.; SPIVAK, G.V.

Exposure of boundary dislocations in germanium by ionic bombardment. Kristallografiia 6 no.2:274-277 Mr-Ap '61. (MIRA 14:9)

1. Moskovskiy gosudarstvennyy universitet im. M.V.Lomonosova.
(Germanium) (Dislocations in crystals) (Ions)

SPIVAK, G.V.; VERTSNER, V.N.; LUK'YANOVICH, V.M.; LEVIN, Ye.Ye.; SKAKOV, Yu.A.

Third All-Union Conference on Electron Microscopy. Radiotekh. i elektron. 6 no.5:852-862 My '61. (MIRA 14:4)
(Electron microscopy--Congresses)

25791
S/048/61/025/005/005/024
B104/B201

24,2200

AUTHORS: Spivak, G. V., Sirotenko, I. G., and Ivanov, R. D.

TITLE: Domain structure of ferromagnetic films produced by cathode sputtering

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya. v. 25, no. 5, 1961, 581-583

TEXT: The present investigation was the subject of a lecture delivered at a symposium on thin ferromagnetic films (Krasnoyarsk, July 4 to 7, 1960). Cathode sputtering was performed in a plasma under an intense discharge and at a low pressure ($2 \cdot 10^{-2}$ - 10^{-3} mm Hg). The free-path length of sputtered atoms was somewhat longer than the distance between target and base layer. The specimen intended for sputtering was connected as the third electrode with a negative potential of 1 kv. A hot cathode served for augmenting discharge current and ion density. The discharge current was of the order of 1 ampere, while that directed onto the specimen to be sputtered was of the order of 1 milliampere. The base layers were made of glass and arranged at a distance of 2 - 3 cm from the

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Domain structure of ferromagnetic ...

target. The specimens to be sputtered were disk-shaped and had an area of about 1 cm^2. The film thickness of permalloy specimens (79% Ni, 17% Fe, 4% Mo) changed linearly with the sputtering time (30-35 minutes), when the specimen potential was 800 v, the discharge current was 0.75 a, the current density to the specimen was 1.6 $ma \cdot cm^{-2}$, and the pressure was $9 \cdot 10^{-3}$ mm Hg. At the same time, the temperature of the specimens ranged from 100 to 125°C. The films formed in a 175-200 oersted magnetic field which was oriented in parallel to the film plane. No annealing processes took place in a magnetic field. Spectroscopic analyses showed that there was no difference between the composition of sputtered films and that of the initial material. The authors were able to observe magnetic powder patterns on 800 Å thick cobalt films. The direction of easiest magnetizing coincided with the magnetic field direction during the process of film sputtering. The sputtering of iron silicide took place under the following conditions: the specimen potential relative to the cathode was 700 v, the current density was 6 $ma \cdot cm^{-2}$, the discharge current was 1 a, the pressure was $8 \cdot 10^{-3}$ mm Hg. The sputtering times were 10, 20, and 30 minutes. The wedge-shaped powder patterns observed on iron silicide

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Domain structure of ferromagnetic ...

films with 3% Si were oriented in the field direction. In films of the abovementioned permalloy composition, produced under "linear" conditions, the sputtering rate had to be increased sharply (discharge current 1 a, potential of specimen 1.2 kv, current density to specimen 2.6 ma/cm^2, pressure $6 \cdot 10^{-3}$ mm Hg) to obtain distinct powder patterns. Differently thick films of this type showed the domains to divide into equal intervals from the thickness of 500 Å onwards. In addition, the domain structure is somewhat increased with larger thicknesses, and the wedges extend in the field direction. On a further increase the wedges are transformed into planes with parallel sides which are oriented in the field direction. The configuration of the domains becomes disordered at 3000 Å. Experimental results are summarized as follows: (1) films can be easily prepared from any material by cathode sputtering; (2) films of defined thicknesses can be obtained under well controlled production conditions; (3) a good uniformity of sputtering and a sufficient rapidity of film preparation are ensured; (4) films thus produced do not differ essentially from the initial material as to their composition. There are 2 figures and 7 non-Soviet-bloc references.

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25791
S/048/61/025/005/009/024
B104/B201

Domain structure of ferromagnetic...

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Division of Physics, Moscow State University imeni M. V. Lomonosov)

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SPIVAK, G.V.; PRYAMKOVA, I.A.; FETISOV, D.V.; KABANOV, A.N.; LAZAREVA, L.V.; SHILINA, A.I.

Mirror-type electron microscope for studying surface structures. Izv.AN SSSR.Ser.fiz. 25 no.6:683-690 Je '61. (MIRA 14:6)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

(Electron microscope)

24803
S/048/61/025/006/003/010
B117/B212

9,4300

AUTHORS: Spivak, G. V., Kushnir, F. F., and Yurasova, V. Ye.

TITLE: УИТ-3 (UIT-3) installation for etching metals, semiconductors and dielectrics through ion bombardment

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25 no. 6, 1961, 707 - 712

TEXT: The present paper has been presented at the 3rd All-Union Conference on Electron Microscopy, held in Leningrad from October 24 to 29, 1960. It describes a new model of a technical installation of type УИТ-3 (UIT-3) for etching metals, semiconductors, and dielectrics through ion bombardment. The models UIT-1 and UIT-2 have been described in Refs. 1 and 2 (Spivak G. V., Yurasova V. Ye., Kushnir F. F., Prilezhayeva I. N., Pribory i tekhnika eksperim., № 2, 106 (1957); Yurasova V. Ye., Spivak G. V., Kushnir F. F., Izv. AN SSSR, Ser. fiz., 23, 744 (1959)). The UIT-3 installation is designed for the following investigations of the surface structure of materials under different conditions: 1) heating of a sputtered specimen not above 1200°C; 2) cooling of the specimen during

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УИТ-3 (UIT-3) installation...

etching with running water; 3) observation of the object surface during sputtering or evaporation by using an optical system with a long focal length; 4) expansion or compression of the specimen during ionic etching or evaporation; 5) application of quartz or metal foils (necessary for the subsequent electron-optical study of the powdered surface) right after ionic etching of the specimens. The UIT-3 installation consists of the following main components: system for generating and measuring the vacuum, feeding device, control console, device for expansion and compression of the specimens, metallographic microscope and a device to sputter and heat the specimens. The vacuum system of UIT-3 is analogous to that of UIT-1. The electric system consists of the following main components: high-tension rectifier for 10 kv and 50 ma; heating current transformer (7 v, 250 a) with a device to transfer the potential either to heat or evaporate the specimen; platinum-platinum-rhodium or chromel-alumel thermo couples with a millivoltmeter for measuring the temperature of the specimen; device for measuring the vacuum and turning on the pumps; interlocks which switch off the high tension when the doors of the installation are opened. Fig. 2 shows a diagram of the UIT-3 installation. The shape of the specimens to be sputtered may be arbitrary if no load is applied. The maximum size of a

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УИТ-3 (UIT-3) installation...

specimen bombarded with ions should not exceed 30 x 30 x 8 mm. When the specimen is heated up to 1200°C it should not be larger than 20 x 20 x 2 mm. During sputtering a specimen having a maximum cross section of 20 mm^2 and a length of 60 mm can be expanded or compressed under a load of 400 kg. Right after the ionic etching a quartz, metal, or carbon foil can be put on the specimen. The ionic etching may create impressions at the edges of the monocrystals which have the symmetry of these edges. The oriented figures, which are obtained by cathode sputtering and corresponds to the symmetry of the surface where they are located, may be used to determine roughly the indices of simplest crystal edges. The application of ionic etching seems very promising to visualize dislocations, especially for heated specimens if chemical etching cannot be used. There are 4 figures and 4 references: 3 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Division of Physics of Moscow State University imeni M. V. Lomonosov)

Card 3/6

24804
S/048/61/025/006/004/010
B117/B212

9.7120 (1003, 1138, 1331)

AUTHORS: Sedov, N. N., Spivak, G. V. and Isayeva, N. F.

TITLE: Electron-optical measurement of electric and magnetic microfields on surfaces

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 6, 1961, 725-729

TEXT: The present paper has been presented at the 3rd All-Union Conference on Electron Microscopy, held in Leningrad from October 24 to 29, 1960. The authors investigated experimentally the quantitative ratio between the strength of the local microfield on the surface of an electron emitter and the image contrast in the image plane. If such a correlation exists, it is possible with an electron-optical emission system not only to observe the electric and magnetic surface microfields but also to measure their strength. Using an additional secondary emission device with an EEM-75 (EEM-75) emission microscope, the structure and distribution of the thermionic emission of effective cathodes has been investigated. Due to such studies it is possible to establish a correlation between the structure

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Electron-optical measurement of ...

and emission of such a heat emitter (Ref. 6: Sbitnikova I. S., Dubinina Ye. M., Spivak G. V., Fetisov D. V., Pribory i tekhnika. eksperim., № 5, 78 (1959); Radiotekhnika i elektronika, 3, 1077 (1958)). A combination of photo- and thermionic emission leads to the same conclusions in the same emission microscope (Ref. 3: Spivak G. V., Pryamkova I. A., Sedov N. N., Izv. AN SSSR. Ser. fiz., 24, 640 (1960)). The microscope used by the authors was similar to that described in Ref. 3. It is a combined glass-metal device. The vacuum was measured to be $(3-5)\cdot10^{-7}$ mm Hg with an external glass casing and good degasification. The magnification of the microscope varied from 50 to 500. A beam catcher not used in the microscope described in Ref. 3 was mounted in the center of the luminescent screen. The microscope was built in several variations with photo- and secondary emission from the surface of the object. In the latter case, the microscope had a socket with an electron gun instead of the lighting device, which was used to bombard the object with about 100-ev electrons. A heater allowed to observe the hot cathodes also during thermionic emission. The possibility of measuring local magnetic fields was checked by using a number of artificial specimens consisting of alternating magnetic and non-magnetic stripes (e.g. iron and copper). The front side of

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Electron-optical measurement of ...

the specimen was polished. Magnetizing was done by an external magnetic field. The distribution of the magnetic field across the specimen and the current density on the screen were compared during focusing onto the area of magnetic inhomogeneities. The image was shifted by means of Helmholtz coils to measure the current density across the individual sections of the specimen. In some cases, the brightness of the luminescent screen was also measured by employing an ФЭУ-19 (FEU-19) photomultiplier in a housing impervious to light. The test results of the brightness of the screen and the direct measurement of the current density on the screen agreed. The magnetic field across the specimen was determined from the change of the resistance of a thin bismuth wire (50 and 100μ diameter). From the typical curves obtained for the magnetic field across the surface of the specimen, it was found that points with maximum values of the magnetic field correspond to a minimum current density on the screen and vice versa. The measurements showed that the relation $j_1/j_2 = H_2/H_1$ (2) is actually fulfilled with an accuracy of 5-10%. (The subscripts 1 and 2 denote the fields and the current density of electrons across the individual sections of the object). The accuracy depends on the exact performance of the experiment and especially on the even lighting of the specimen. With the given

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Electron-optical measurement of ...

accuracy it is possible to measure small magnetic fields which are difficult to measure by other methods. Measurements of magnetic fields were done with artificial inhomogeneities of ~0.1 mm. At present, this method is applied to measure natural magnetic microfields which can be found in a number of objects. Active heat emitters were also investigated. The current density of individual sections of pressed cathodes was measured in the temperature range from 600° - 800°C. The lower temperature limit was determined by the thermionic emission. The upper limit was determined by the blurring of the image caused by the space charge. Richardson lines were drawn by using the temperature dependence of the current density. The work function determined from the inclination of the straight lines ranged from 1.9-3.1 ev. Most of the emission spots had a work function close to the lower value. If the spacing of the spots and the difference of the contact potentials determined from the difference of the work function are known; then it is possible to estimate the field potential of the spots for the object in question. It is in the order of several kv/cm. Electron-optical emission systems make it possible to determine magnetic and electric microfields on the surface not only qualitatively but also quantitatively. The authors thank the student E. Sh. Gasparyan for cooperation and A. I. Shal'nikov for

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24806
S/048/61/025/006/006/010
B117/B212

9.4300

AUTHORS: Sirotenko, L.D., Spivak, G.V., Stoyanova, I.G. and Osad'ko, Z.M.

TITLE: Electron microscopic study of thread-like semiconductor crystals

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25 no. 6, 1961, 735-738

TEXT: The present paper has been presented at the 3rd All-Union Conference on Electron Microscopy held in Leningrad from October 24 to 29, 1960. The authors investigated thread-like crystals of tungsten and molybdenum oxides with the use of a [illegible] electron microscope. This model (Ref.2: Stoyanova I.G., Gaydaev P.V., Pribory i tekhnika eksperim., №3, 138 (1959)) was developed for investigations in gas media. Tungsten or molybdenum loops with the thread-like crystals grown on them were put in the object chamber of such a microscope for electron-microscopic or electron-diffraction studies. Form and condition of the surface of the thread-like semiconductor crystals were studied together with the form of their points. Electron-diffraction studies showed that thread-like crystals

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S/048/61/025/006/006/010
B117/B212

Electron-microscopic study

of tungsten and molybdenum oxides are monocrystals. A 2,000-fold magnification shows tungsten oxide crystals to be straight and to have a constant cross section. The points appear flattened and the faces smooth. A close study shows protrusions on the faces of some crystals, which seem to form a spiral around the crystal. This is distinctly shown by a 7,500-fold magnification. Cross sections and lengths vary greatly for each crystal. It seems that the crystals first grow in axial direction till they reach a certain length and then their radial growth starts. Due to the growth of new layers the crystals become thicker. The number of molybdenum-oxide crystals growing per unit area of wire is much smaller than that of tungsten-oxide crystals; also their form is different, which might be caused by their growth conditions. They are straight and have smooth faces without protrusions. Very often they are conical and have pointed ends. The tungsten-oxide and molybdenum-oxide crystals grown on a wire loop were mounted in an autoelectronic projector. The vacuum was created by a fore-pump and a mercury diffusion pump. After annealing the tube and freezing out the mercury vapor, a vacuum of 10^{-7} mm Hg was reached, which was improved with the help of a titanium diffuser. At a potential of 4 - 7 kv there appear single blurred luminous spots on the screen on the projector, which

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Electron-microscopic study ...

correspond to the emission of the various thread-like crystals. The image might change when the potential is raised: The images of single thread-like crystals (of smaller diameter) disappear, while the images of others appear. The crystals resist a lasting heating to red heat of the wire. Due to the heating of the crystals, the same emission current will be observed with a potential increase. Some emission images disappear and the screen luminesces evenly. It is assumed that the ends are rounded off during heating and the images of some crystals overlap. Quite often one can see images on the screen, which consist of four individual luminous spots. Sometimes it can be observed how the image is rotating by 90° around its axis. This might take place under the effect of ion bombardment of residual gases. Very seldom it was observed that a sudden rotation took place when increasing the potential, with a subsequent disappearance of the image. It is possible that these phenomena are related to the occurrence of a screw crystal emission and to a stripping of these crystals by the field. Investigations of the thread-like crystals after the test showed that their ends become pointed due to ion bombardment. The ion bombardment is the main cause for the instability of cold cathodes (Ref.5: Elinson M.I., Vasil'yev G.V., Avtoelektronnaya emissiya. Fizmatgiz, M., 1958). A fairly stable

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Electron-microscopic study ...

current can be expected from crystals having the form of straight needles of a small diameter. Studies of the effect of ion bombardment on the emission properties of thread-like crystals showed that the emission current increases by a multiple and reaches up to 300 μa. The stability of the emission current also increases. At the same time, more four-leaf images can be observed on the screen. For a certain "point brush", the conditions furnishing constant emission currents are chosen experimentally. Ther are 7 figures and 7 references: 5 Soviet-bloc and 2 non-Soviet-bloc.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M.V. Lomonosova (Division of Physics of Moscow State University imeni M.V. Lomonosov)

24807

S/048/61/025/006/007/010
B117/B212

9.4300 (1055, 1163, 1482)

AUTHORS: Lazareva, L.V. and Spivak, G.V.

TITLE: Electron-microscopic observations of magnetic microfields by using impressions

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 6, 1961, 742-747

TEXT: The present paper has been presented at the 3rd All-Union Conference on Electron Microscopy, held in Leningrad from October 24 to 29, 1960. The authors report on an electron-microscopic method which makes it possible to relate the surface geometry of a ferromagnetic material with its micromagnetic structure. The method is based on an impression taken of the specimen itself but not of the ferromagnetic powder dusted on the object. This method has the following advantages: 1) The impression taken directly from the specimen depends neither on the magnetic nor on the geometric data of the powder. Therefore, high magnifications and also more exact studies of the magnetic-geometric characteristics are possible. 2) Magnetic and structural properties (microgeometry) of the material can

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Electron-microscopic observations ...

be studied simultaneously. The microgeometry of the specimens was investigated by means of carbon or quartz impressions and a transmission electron microscope. At the same time, the magnetic structure corresponding to the state of the specimens (annealed, mechanically or electrolytically polished, stretched) was investigated by the powder method. Textured ferrosilicon (3% Si) was chosen for the tests. About 10 different specimens were studied. The results are characteristic and well reproducible. It was found that the crystallites are oriented nearly parallel to the (110) plane in the rolling direction, and along the direction of rolling they are oriented in the [100] direction. For ferrosilicon this is the direction of easiest magnetization. Monocrystals were etched out from single large crystallites by using nitric acid. The crystallographic orientation of the specimens was determined by X-ray photographs. The specimens were chosen such that the surface investigated was located in a rolling plane inclined at an angle of 2 - 3° to the crystallographic plane (110). The specimens used were of various geometrical shapes (disks, rectangles and polygons) with surfaces ranging from 0.5 cm^2 to several centimeters, and thicknesses from 0.3 - 1.5 mm. The monocrystal was

polished mechanically. The powder patterns in the optical microscope are typical of such specimens for the (110) plane if stresses are present. The type of mosaic structure depends on the grinding direction and does not seem to represent the structure of the internal domains. It is known that the boundaries of the mosaic zigzag. A value of 106° was obtained for stable zigzag angles of ferrosilicon (Ref.11: Chikazumi S., Suzuki K., J. Phys. Soc. Japan, 10, 523 (1955); "Magnitnaya struktura ferromagnetikov" str. 204. Pod red. S.V. Vonsovskogo. IL, 1959). This angle will be smaller than 106° if strong stresses are present in the crystal. Measurements of specimens with varying stresses showed values between 80° and 110°, which agree with the theoretical values. For studies without stresses the specimens were polished electrolytically; after that they were annealed in vacuo at 1000°C for 3 hr and then cooled slowly. The powder patterns which represent the magnetic structure of an annealed specimen, are parallel straight lines. They cover the whole surface and are characteristic of the (110) plane of ferrosilicon. It can be assumed that the line relief is caused by cold rolling of the material, and that the character of the linear magnetic domains of annealed specimens is closely connected with the character of the microstructure. Investigations have shown that strong internal stresses

caused by thermal treatment will change the magnetic structure of the specimens. In the present paper, it has been found that there is a certain relation between the microgeometry at the surface of ferrosilicon specimens and the character of their magnetic structure. The stresses caused by mechanical or thermal treatment seem to cause a change of the microgeometry at the surface of the specimen. This can be explained by the anisotropy of the striction properties. The totality of all changes, appearing in the specimen due to anisotropy of the mechanical and magnetic properties will bring about the magnetic structure characterizing the state of the material. Ya.S. Shur, V.R. Abel's, L.V. Kirenskiy, V.V. Veter are mentioned. There are 8 figures and 15 references: 9 Soviet-bloc and 6 non-Soviet-bloc.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos.universiteta im. M.V. Lomonosova (Division of Physics of Moscow State University imeni M.V. Lomonosov)

S/048/61/025/012/007/022
B116/B138

AUTHORS: Spivak, G. V., Kirenskiy, L. V., Ivanov, R. D., and Sedov, N. N.

TITLE: Development of mirror-type electron microscopy of magnetic microfields

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 12, 1961, 1465 - 1469

TEXT: The authors present electron-optical photomicrographs of domain structures of various ferromagnetic materials and compare them with powder patterns. The distribution of the local magnetic fields scattered by the specimen is obtained from the contrast. G. V. Spivak, I. N. Prilezhayeva, and V. K. Azovtsev (Dokl. AN SSSR, 105, 965 (1955)) were the first to recommend the electron mirror for photographing magnetic microfields. They carried out their experiments at the laboratoriya elektronnoy optiki MGU (Electron Optics Laboratory of MGU). The electron mirror has the following advantages over the methods of secondary electron emission or photoeffect: high field sensitivity (the illuminating electron beam is stopped by an

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Development of mirror-type...

electric field in front of the specimen, i. e. "probing" of the spatial field structure; high contrast, due to the forwards and backwards motion of the electron; and the possibility of examining the magnetic structure at different distances from the source of the microfield. The optical system can be traversed by both slow and fast electrons. A 50-kv voltage focuses the reflected electrons and enhances the resolving power of the instrument. Domain structure electron-mirror pictures of a $PbO(Fe_2O_3)_6$ crystal magnification: 400, 800, and 1500), cobalt (400 and 800), and a cobalt film (~1000 Å, 400 times), were in good agreement with ones produced by the powder method (400). The local magnetic fields were determined from the contrast. Calculations have shown that the contrast depends on the product Hz (z = extent of the H-field). The magnetic field decreases almost exponentially. Results are shown in Fig. 6. Finally it is noted that magnetic fields can be examined under an electron mirror microscope and that their their strength can be measured at different distances from the specimen. The magnification here achieved (about 2000) can be further increased. There are 6 figures and 7 Soviet references.

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ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Division of Physics of Moscow State University imeni M. V. Lomonosov), Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR (Institute of Physics of the Siberian Department of the Academy of Sdiences USSR)

Fig. 6. (a) Field above the artificial specimen, measured with a bismuth micrometer at different magnetic biasing currents $H = H_0 e^{-z/z_0}$; (b) mirror calibration curve; (c) scattering field above the hexagonal plane of the $PbO(Fe_2O_3)_6$ crystal, $z_0 = 0.02$ mm; (d) scattering field above the hexagonal axis which is nearly parallel to the cobalt face, $z_0 = 0.05$ mm. Legend: z_0 is a constant, B_1 and B_2 are the various degrees of brightness on the screen.

31608
S/048/61/025/012/022/022
B125/B112

9,2300 (1110, 1104, 1385)

AUTHORS: Ivanov, R. D., Spivak, G. V., and Kislova, G. K.

TITLE: The properties of ferromagnetic films produced by cathode sputtering

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 12, 1961, 1524-1525

TEXT: A method worked out by G. V. Spivak, I. G. Sirotenko, and R. D. Ivanov (Izv. AN SSSR. Ser. fiz., 25, 581 (1961) for the production of one-component and multicomponent ferromagnetic films of high quality by cathode sputtering was improved. The magnetization curves and the hysteresis loops of such films were studied and the most important loop parameters were determined by a magneto-optic method, suggested by G. S. Krinchik (Fizika tverdogo tela, 2, no. 8 (1960)) which uses the equatorial Kerr effect. Polarized light incident on the surface of the film through two windows in the discharge tube, was transmitted to a photoelectric cell by reflexion. In case of static operation, the hysteresis loop was recorded by means of a bridge circuit with two selenium photoelectric

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cells of the type СФ-10 (SF-10) and with a galvanometer М21/2 (M21/2) without exposing the film to the atmosphere. During the formation of the ferromagnetic films their properties were checked constantly. All the films were sputtered to hot surfaces under approximately equal conditions (amperage of the discharge current 0.5-1 a, potential of the specimen with respect to the cathode 1.8-2.2 kv, krypton pressure in the tube $(4\text{-}2)\cdot10^{-3}$ mm Hg, current density in the specimen 1-3 ma cm^{-2}, generating field -44.2 oe, period of sputtering $\leq$ 2-5 minutes) and their magnetization was reversed in direction of weak magnetization. The film was then exposed to air and the change in the coercive force was studied. The coercive force which is rather small prior to oxidation increased notably at the beginning and more reluctantly in the further course of time. An analogous behavior of H_c can be observed also in other ferromagnetic films. Adequate measures should be taken to protect the film exposed to the atmosphere and the essential parts of the receiver should be made so as to permit recording of the whole magnetization process by oscilloscopes. There are 3 figures and 2 Soviet references.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Physics Department of the Moscow State University imeni M. V. Lomonosov)

23734
S/057/61/031/006/018/019
B116/B201

9,4300 (1072, 1164, 1385) also 1145, 1160, 1147

AUTH: Spivak, G. V., Sirotenko, I. G., and Ivanov, R. D.

TITLE: Micromagnetic structure of films obtained by cathode sputtering

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 6, 1961, 754 - 756

TEXT: A description is given of the application of intense cathode sputtering for the purpose of obtaining different ferromagnetic films. Compared with existing methods, this one is shown to display a number of advantages. The domain structure and its changes have been observed on ferromagnetic cobalt films, molybdenum-permalloy films (79Ni 17Fe 4Mo), and silicon-iron films (3.3% Si) with the aid of powder patterns. The characteristics of the change of the domain structure with a change of thickness have been established on molybdenum-permalloy films. Ferromagnetic films are usually obtained by vacuum evaporation or by electrodeposition. Such methods, however, display a number of essential drawbacks: 1) The chemical composition of the film differs from that of the initial material; 2) difficulties arise in the preparation of homogeneous films of a desired

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S/057/61/031/006/018/019
B116/B201

Micromagnetic structure of films...

thickness. An attempt has been made by G. Siddall (Ref. 1: Proc. Inst. Electronics 3, 34, 1958) and G. Wehner (Ref. 2: Adv. in Electronics a. Electron Phys., 7, 239, 1955) to obtain films of different metals by cathode sputtering. A paper by L. Reimer (Ref. 3: Za. f. Phys., 149, 425, 1957) describes attempts to prepare nickel films by cathode sputtering. These experiments, however, were conducted with relatively weak discharge currents and in a glow discharge; in addition, relatively high gas pressures (of 0.1 mm Hg and more) were applied. In such a case, a long time is needed to obtain films of a desired thickness, which, however, causes the film to be polluted and oxidized. The authors of the present paper have carried out an intense cathode sputtering in the plasma of a low-pressure discharge ($2 \cdot 10^{-2}$ - 10^{-3} mm Hg). The mean free path was in this case larger than the distance between the bombarded target and the base on which the film was formed. The sputtered specimens were introduced into the plasma as the third electrode with a negative potential of the order of 1 kv with respect to the cathode. A hot cathode was used to raise the density of the discharge current. The discharge current was of the order of some amperes, and the current applied to the sputtered specimen was of the order of some

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milliamperes. The glass bases onto which the films were sputtered, were placed at a distance of 2 - 3 cm from the target. The setup used was so constructed as to allow several films to be submitted to sputtering simultaneously, without having to interrupt the sputtering process. The disk-shaped sputtered specimens had an area of 1 cm^2, which ensured a sufficient deposition of the sputtered material onto the base. The film thickness varied linearly with time. Therefore, the thickness could be easily regulated by changing the sputtering time; thus, films of any desired thickness were obtained. The film thickness was measured with an MII-5 (MII - 5) microinterferometer. The glass bases were heated up to 100 - 125°C. The films formed in a magnetic film of the order of 175 - 200 oersteds, which was parallel to the plane of the base. Quantitative chemical and spectroscopic analyses of films obtained by cathode sputtering and with different modes of operation showed that their composition did not differ from the initial components in the sputtered materials. The domain structure was observed on the films with the aid of powder patterns. When submitting molybdenum-permalloy films to sputtering, the specimen potential amounted to 800 v, the discharge current was 0.75 a, the density of the current to the specimen was 1.6 ma/cm, and the pressure was 9.10 mm Hg. The domain walls

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changed in appearance with an increase of the film thickness. The silicon-iron films, on which wedge-shaped powder patterns were established, were submitted to sputtering at a specimen potential of 700 v, a current density of 6 ma/cm^2, a discharge current of 1 a, and a pressure of $8 \cdot 10^{-3}$ mm Hg. The method described here for obtaining ferromagnetic films by intense cathode sputtering is characterized by the following circumstances: 1) It is possible to obtain high-quality films of different thicknesses under easily controllable conditions; 2) cathode sputtering may be applied with materials of any melting temperatures; 3) uniform sputtering and pure films are ensured; 4) most important, the films obtained display only small deviations from the composition of the sputtered ferromagnetic substances. [Abstracter's note: Essentially complete translation.] There are 2 figures and 3 non-Soviet-bloc references.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M. V. Lomonosova Fizicheskiy fakul'tet (Moscow State University imeni M. V. Lomonosov, Division of Physics)

SUBMITTED: September 16, 1960

Card 4/4

SPIVAK, G.V.; KROKHINA, A.I.; TEREMETSKAYA, A.G.; TERNOVSKAYA, M.V.

Studying the microstructure of ore minerals by ion bombardment.
Zap.Vses.min.ob-va 90 no.6:695-697 '61. (MIRA 15:2)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta.
(Mineralogy)

S/048/62/026/011/003/021
B125/B102

AUTHORS: Sedov, N. N., Spivak, G. V., and Ivanov, R. D.

TITLE: Electron-optical study of a p-n junction in germanium and silicon

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 11, 1962, 1332-1338

TEXT: The authors describe an electron-microscopic method of examining a p-n junction with the help of ion-induced electron emission. This method offers the following advantages: (1) The surface of the specimen and the junction can be examined simultaneously; (2) the overall length of the junction is visible; (3) the image is not darkened by any auxiliary grid; (4) the method is likely to be suitable also for greater enlargements; (5) quantitative measurement of the potential distribution in the p-n junction is very simple. The secondary electrons are knocked out of the specimen by positive ions of 3-4 kev and then are accelerated and focused with the immersion objective of a high-quality emission microscope with improved metal mirror. Such secondary emission microscopes are

Electron-optical study of a ...

particularly suitable for examining semiconductors with surface junctions that are not heated. The photographs are taken inside the vacuum chamber. The disturbances of the accelerating field that arise over the p-n junction bend the electron trajectories. The electrons deflected by these disturbances are kept away from the screen of the microscope by an aperture stop. When a voltage of 5-10 v is applied in the back direction, the image of the p-n junction assumes the shape of a dark band which need not be straight and which broadens as voltage increases. The range of the potential in the p-n junction can be determined from a comparison between the secondary emission image and the electron mirror. The construction of a mirror electron microscope was described by G. V. Spivak et al. (Izv. AN SSSR, Ser. fiz., 25, 683 (1961)). The shape of the potential barrier on the p-n junction was determined by using the sharp contrast between the reflected image of the surface and the boundary of the "spot" of secondary emission. The method described here permits measurements at sufficiently small intervals. Its accuracy is dependent upon the properties of the electron mirror which is more sensitive to inhomogeneities, such as p-n junctions, than is an electron microscope with ion-induced electron emission because the impurities change the work

S/048/62/026/011/003/021
B125/B102

Electron-optical study of a ...

function. There are 10 figures.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Physics Division of the Moscow State University imeni M. V. Lomonosov)

Card 3/3

S/048/62/026/011/004/021
B125/B102

AUTHORS: Spivak, G. V., Saparin, G. V., and Pereverzev, N. A.

TITLE: The potential distribution found in a p-n junction by means of an electron-optical raster system

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 11, 1962, 1339-1342

TEXT: The authors discuss the possibility of visualizing the junction and of quantitatively measuring the range of the potential in p-n junctions of germanium and silicon single crystals directly and quickly, using an electron beam that scans over the surface. The method is based on the following assumptions: (1) The radius of the scanning beam has to be smaller than the width of the p-n junction; (2) the potential drop in the junction must be greater than the mean energy of the secondary electrons. The accuracy of the method in weak fields can be improved by reducing the electron energy and when the radius of the electron probe is reduced, the method can be applied to measuring potentials of thin junctions. The width of the junction can also be determined by varying the blocking

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voltage. The potential distribution of a p-n junction is determined with the integrating circuit (12) and the oscilloscope (13) (Fig. 1). If the blocking voltage is given, the width of the junction determined by the electron-optical method is 25-30% greater than that measured with a micromanipulator. The method described here furnishes data on the dependence of the electrical structure of a p-n junction on various factors. The device displays 600 scanning lines and supplies 50 frames per sec. There are 7 figures.

ASSOCIATION: Fizicheskiy fakul'tet Moskovskogo gos. universiteta im. M. V. Lomonosova (Physics Division of the Moscow State University imeni M. V. Lomonosov)

Fig. 1. Block diagram of the electron-optical raster system.
Legend: (1) electron gun; (2) anode cylinder; (3)-(4) magnetic lenses; (5) deflecting coils; (6) object; (7) collector; (8) amplifier; (9) the deflecting coils in the circuit of the electron probe are connected in series to the kinescope; (11) kinescope.

S/181/63/005/002/024/051
B104/B102

AUTHORS: Predvoditelev, A. A., Spivak, G. V., Kotova, A. M., Yurasova, V. Ye., and Kushnir, F. F.

TITLE: Study of non-decored dislocations in zinc single crystals by ion bombardment

PERIODICAL: Fizika tverdogo tela, v. 5, no. 2, 1963, 542-545

TEXT: This paper is aimed to prove the possibility of detecting "virgin" dislocations by ion bombardment of single-crystal faces. Cylindrical zinc single crystals (2.5 mm in diameter, 50 mm high) were split along the (0001) plane at nitrogen temperature and the faces were bombarded with ions in flowing neon gas. Thin pieces of specimens that had been bombarded with ions on both (0001) planes showed the same etch patterns on both sides. Repeated etching of any one surface section produces no new etch patterns but intensifies those existing. The results from chemical etching and from ion bombardment are consistent. The most favorable experimental conditions are: neon pressure between $6 \cdot 10^{-2}$ and

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Study of non-decored dislocations ...

$3 \cdot 10^{-2}$ mm Hg, voltage between anode and specimen between 1.5 and 1.75 kv, current density at the specimen 1.2 a/cm^2, bombardment period, approximately one hour. There are 5 figures.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M. V. Lomonosova(Moscow State University imeni M. V. Lomonosov)

SUBMITTED: June 23, 1962 (initially)
August 29, 1962 (after revision)

SPIVAK, G.V.; YURASOVA, V.Ye.; KUSHNIR, F.F.

UIT-r apparatus for fast etching of metals, semiconductors, and dielectrics by ionic bombardment. Izv. AN SSSR. Ser. fiz. 27 no.9:1188-1192 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. Lomonosova.
(Electronic apparatus and appliances) (Ion beams)

SPIVAK, G.V.; IVANOV, R.D.; PAVLYUCHENKO, O.P.; SEDOV, N.N.

Formation of contrast in mirror-type, emission, and scanning electron-optical systems. Izv. AN SSSR. Ser. fiz. 27 no.9: 1139-1146 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. Lomonosova.

(Electron microscope)

SEDOV, N.N.; SPIVAK, G.V.; DYUKOV, V.G.

Use of an emission electron microscope in studying semiconductors and dielectrics. Izv. AN SSSR. Ser. fiz. 27 no.9:1173-1178 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

(Electron microscopy)

SEDOV, N.N.; SPIVAK, G.V.; DYUKOV, V.G.

Use of an emission electron microscope in measuring the potential distribution in a p-n junction. Izv. AN SSSR. Ser. fiz. 27 no.9: 1179-1183 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. Lomonosova.

(Electron microscopy) (Junction transistors)

SPIVAK, G.V.; LUK'YANOV, A.Ye.; TOSHEV, S.D.; KOPTSIK, V.A.

Observation of the domain structure of triglycine sulfate by means of an electron mirror. Izv. AN SSSR. Ser. fiz. 27 no.9:1199-1202 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im.M.V.Lomonosova.

(Glycine) (Domain structure)
(Electronic apparatus and appliances)

L 19956-63 EWT(l)/EWG(k)/EWP(q)/EWT(m)/EEC(b)-2/EWP(b)/EDS
AFFTC/ASD/ESD-3/IJP(C)-P-4-AT/JD
ACCESSION NR: AP3007825 S/0048/63/027/009/1203/1206

AUTHOR: Spivak, G.V.; Ivanov, R.D.

TITLE: A mirror electron microscope and its use for quantitative investigation of semiconductors /Report, Fourth All-Union Conference on Electron Microscopy held in Sumy* 12-14 March 1963/

SOURCE: AN SSSR, Izv.Ser.fizicheskaya, v.27, no.9, 1963, 1203-1206

TOPIC TAGS: p-n junction , semiconductor , electron microscopy

ABSTRACT: The paper is a general report on investigations of the width of p-n junctions and the potential distribution across them by means of a mirror electron microscope. These investigations are part of comprehensive studies of p-n junctions on semiconductors by different techniques. The mirror microscope has been described elsewhere (G.V.Spivak and others, Izv.AN SSSR,Ser.fiz.,25, 683, 1961). For the present work there was built a special specimen holder with provision for applying a blocking voltage to the p-n junction, heating the specimen, and measuring the temperature by means of a thermocouple (see Enclosure) for the purposes one of the purposes was to investigate the effect of temperature. The

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L 19956-63
ACCESSION NR: AP3007825

junction in mirror microscopes is visualized by displacement of the boundary of secondary emission across the junction incident to variation of the potential applied to the semiconductor specimen. Actually the electric field emerging to the surface of the junction usually combines with the field due to a poorly conducting film that forms on the surface, so that the observed pattern is a superposition of the two fields, which are characterized by different dependences on the temperature of the specimen (hence the interest in heating the specimen). Six micrographs of germanium surfaces are reproduced, as well as a family of curves characterizing the variation of the junction width with applied voltage at 30, 60 and 120°C. Some of the microphotographs illustrate the results of heating. Orig.art.has: 6 figures.

ASSOCIATION: Fizicheskiy fakultet Moskovskogo gos.universiteta im.M.V.Lomonosova (Physics Department, Moscow State University)

SUBMITTED: 00 DATE ACQ: 07Oct63 ENCL: 01

SUB CODE: PH, SD NO REF SOV: 006 OTHER: 000

Card 2/8

SPIVAK, G.V.; IVANOV, R.D.; PAVLYUCHENKO, O.P.; SEDOV, N.N.; SHVETS, V.F.

Visualization of a magnetic sound-recording field by means of an electron mirror. Izv. AN SSSR. Ser. fiz. 27 no.9:1210-1218 S '63. (MIRA 16:9)

1. Fizicheskiy fakul'tet Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

(Electron optics) (Magnetic fields)

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