ENERGY DISTRIBUTION OF NEGATIVE IONS IN HYDROGEN AND ARGON POSITIVE IONS BOMBARDEMENT OF ALUMINIUM SURFACE.

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In investigations of the ion beams passing through the output little channel of the asymmetric Penning discharge reflex electrode a measurement is made of the negative ions producted in the central region of the cathode. The negative ions are created as a result of the positive plasma ions bombardement of the polycrystalline aluminium cathode surface. The ions are incident on the surface normally with the energy U_p proportional to the cathode potential drop. After acceleration and decelaration in the cathode and reflection electrode potential drops respectively, the secondary negative ions leave the Penning discharge tube and their energy and mass (M=1-40) are analysed by the electrostatic toroidal analyser with resolving power about 0,8 eV and by the sector magnetic field.

The energy distribution of the secondary negative ions created by the positive ions H_1^+, H_2^+, and H_3^+ (the Penning discharge in hydrogen) is shown in Fig. 1. The peak of the negative ions with the energy about 1,5 eV is formed by the negative ions O^-, OH^-, H^- and partly by Cl^- and CN^- ($C_2H_2^-$) [1]. The mass spectrum suggests that the negative ions are created in the interaction of positive ions with the molecular layer adsorbed at the metal surface. The high energy tail was found (see Fig. 2.) which is formed by the negative ions H^- created in the dissociative collisions of the positive ions with lattice atoms and in the attachement of two electrons. The negative ions are ejected with the high kinetic energy up to 0,5 U_p [2].

The energy distribution of the negative ions from the Penning discharge in argon is shown in Fig. 3. and 4. No high energy tail was found because of inability of the Ar^+ ions to attach electrons.

The shape of the energy distribution of the negative ions from the metal

surface is distorted by the presence of negative ions created in the collisions of positive ions with neutral gas molecules (discharge tube gas pressure $p=1.10^{-3}$ Torr). In the Ar discharge the generation of the negative ions near the cathode is limited, as it is seen from the comparison of Fig. 1. with 3.

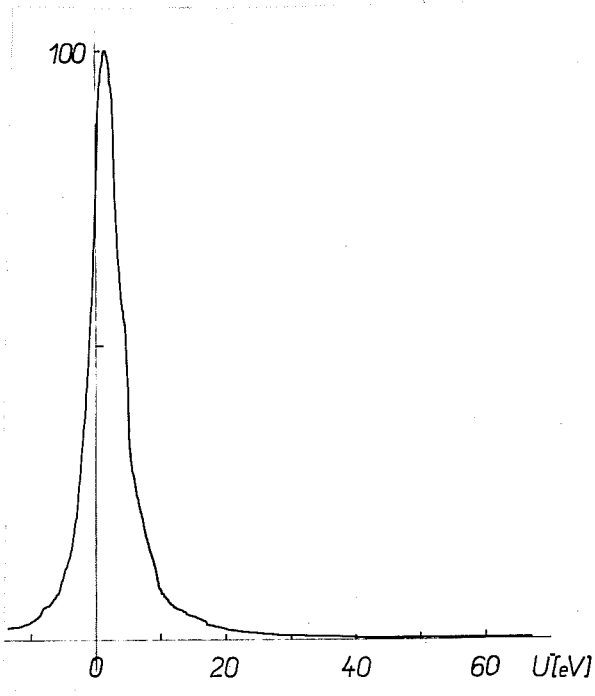

Fig. 1.

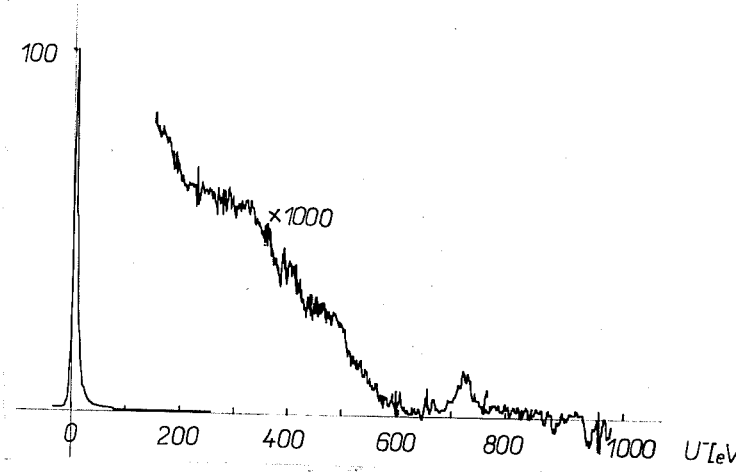

Fig. 2.

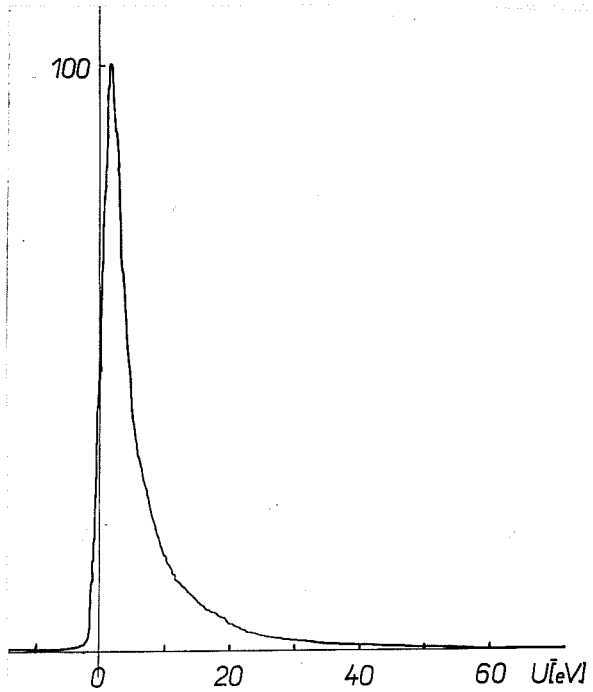

Fig. 3.

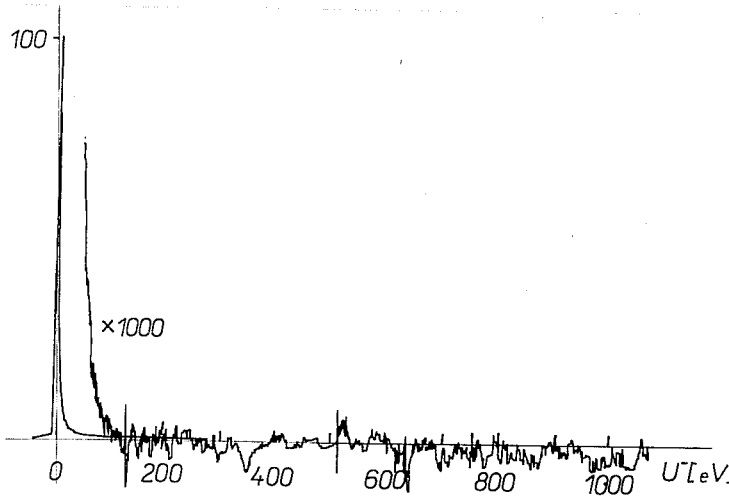

Fig. 4.

References: [1] M. Kaminsky: Atomic and ionic impact phenomena on metal surfaces, Berlin 1965

[2] L.P. Levine: Phys. Rev. 118 (1960), 158