

Apparatus for the study of secondary ions from solid surfaces under ion bombardment

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In order to study the interaction of ions with solid surfaces, we have developed a quadrupole mass spectrometer to analyse the secondary sputtered ions arising due to ion-solid interaction. Of particular interest is the emission of singly charged, molecular cluster ions, characteristic of the solid sample.

The setting up of a quadrupole mass spectrometer has already been reported by Dey *et al* (1975). The mass spectrometer could handle mass up to ~ 100 , the radio-frequency used having been 4 mc/sec. In order to handle heavier mass, certain changes were incorporated in the electronic circuitry. With the limited r.f. power available for the generation of the r.f. field in the space between the rods of the quadrupole analyser, the frequency of the r.f. system had to be changed from 4 mc/sec to 3 mc/sec. Having done this, we have been able to extend the mass range of the instrument up to about 200.

An ion-source, developed by Uhler *et al* (1968), has been set up and tested to generate energetic ions (up to ~ 10 KeV) for bombardment purposes. The testing was done using Ar and Zn. The ion-source is capable of handling both solids and gases. The energetic ions were made incident on a polycrystalline surface inclined at an angle of 45° with the direction of the primary ion beam. The primary current density at the target surface was (2-3) ma/cm². The secondary sputtered ions, ejected from the target surface were extracted, accelerated and collimated by a lens system at 90° to the primary beam direction. The secondary ions were then passed through the quadrupole field, the last ground slit in front of the quadrupole had a circular aperture of diameter 14 mil. A block diagram of the experimental set-up is shown in Fig. 1. The chamber enclosing the ion-source, target box, quadrupole mass filter and the electron multiplier etc. was evacuated up to a pressure $\sim 10^{-5}$ mm of Hg by oil diffusion pumps provided with liquid air traps.

So far we have bombarded polycrystalline copper surfaces using energetic Zn⁺ ions. The copper sample was electrolytically pure. Sputtering yield is

higher if lighter targets are bombarded by heavier projectile ions. It is planned to bombard Cu, Al and Ni targets by Zn^+ and Cd^+ ions.

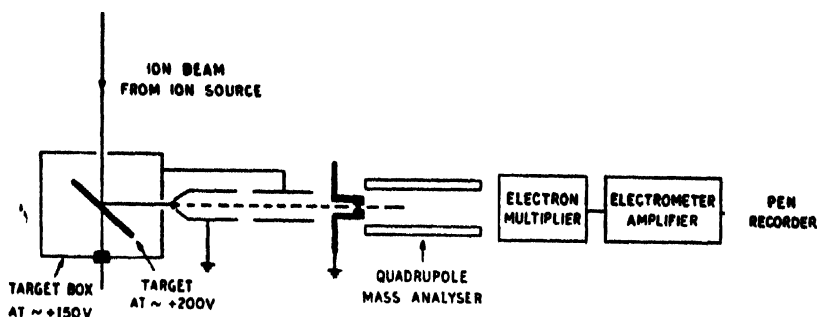


Fig. 1. Block diagram of the experimental set-up.

A preliminary analysis of the secondary ions produced due to Zn^+ —Cu interaction showed presence of Cu^{++} , Cu^+ , Cu^{+2} , Cu^{+3} and CuO^+ ions. The ions, after being analysed by the quadrupole mass spectrometer, were detected by a 10-stage Ag-Mg electron multiplier, (Dumont SP. 182) operated at a gain of 10^6 , followed by a vibratingreed electrometer and a pen recorder.

REFERENCES

- Dey S. D., Karmohapatra S. B. and Banerjee B. M. 1975 *Ind. J. Phys.* **49**, 797,
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