Ultramicroscopy 4 (1979) 361–391

Abstracts of Papers Presented at

The 25th International Field Emission Symposium

July 17-22, 1978
Albuquerque, New Mexico

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Abstracts of the contributions in the various topics may be found grouped according to the indicated pages:

SURFACE ANALYSIS OF FIELD-EMITTER SAMPLES EXPOSED TO THE PLASMAS OF PLT AND ISX*

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In an attempt to help characterize the plasma-wall interactions in operating tokamak reactors, the Imaging Atom-Probe mass spectrometer (IAP), the Field-Ion Microscope (FIM), and the Transmission Electron Microscope (TEM) have been used to analyze the surface and near-surface region of field-emitter samples which were placed at the wall position and exposed to the plasmas of the Princeton Large Torus (PLT) and the Impurities Study Experiment (ISX) tokamak fusion reactors. Measurements of the extent of damage to the specimen surfaces, the composition and thickness of deposited surface films, and the depth distribution of low energy plasma species implanted into the near-surface region of the samples have been carried out.

Three sets of samples (two in PLT and one in ISX) have been investigated thus far. Although each set was subjected to different exposure conditions (e.g., type and number of plasma discharges, limiter material used, position of samples with respect to limiters), some consistent results from the analysis of the samples have been found. For example, all of the tips which had direct plasma exposure showed evidence for a change in surface morphology (i.e., lattice damage or deposited surface films), whereas those tips which were placed in the reactor at the same time but shielded from line-of-sight exposure to the plasma were apparently unchanged. Mass spectra obtained with the IAP showed that plasma and impurity species become trapped within the damaged regions and deposited films, but are not implanted into the substrate bulk.

The implications of these results (and others to be presented) as they relate to the plasma-wall interactions in operating tokamaks will be discussed.

*This work was supported by the United States Department of Energy (DOE) under Contract AT(29-1)789 and carried out in cooperation with S. A. Cohen and H. F. Dylla at PPPL and R. E. Clausing at ORNL.

FIELD ION MICROSCOPY OF TUNGSTEN IRRADIATED WITH He^+, O^+ AND Ar^+ ION PARTICLES

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Hitherto we have investigated FIM observation of tungsten irradiated with C^+ ions. In this study the purity of the specimen was 99.95%, annealed at 1800°C for 2 hrs. For comparison of radiation damage with other charged particles, tungsten wires were irradiated with 80 keV He^+, 300 keV O^+ and 300 keV Ar^+ ions. The irradiation temperature was 30°C for He^+ and 30-200 C for O^+ and Ar^+. The size distribution of vacancy clusters was investigated after each irradiation. In the case of He^+ irradiation the larger vacancy clusters between 10-15 Å was not observed. This would be due to less primary knock-on energy in He^+ irradiation compared with the case of O^+ and Ar^+ irradiation. The swelling $\Delta V/V$ was plotted against the radiation damage. $\Delta V/V$ showed saturation tendency in the earlier stages above 0.5 dpa in the case of O^+ and Ar^+ irradiation, and the value was higher than in the case of He^+ irradiation. This would be also due to higher primary knock-on energy, and the interstitials almost escaped from the surface in the earlier stage in the case of Ar^+ and O^+ irradiation.

A DISCRETE-CHARGE MODEL OF A FIELD-ION EMITTER SURFACE

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This paper explores some of the properties of a basic version of a new type of charged-surface model in which the surface atoms in a charged surface are represented in terms of an array of superimposed monopoles and dipoles, together with a distant array of monopoles of the opposite sign. (The distant array is necessary for electrostatic self-consistency.)

The model is a development of earlier work by the present author and by Tsong and Müller, and can be regarded as a significant step forward from the normal description of charged surfaces provided by classical electrostatics. The need for such a model seems an unrealized consequence of the Hellman-Feynman theorem.

Exploration of the model brings out