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UHV MICROSCOPY OF SURFACES: RECENT RESULTS

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In order to examine surfaces of materials, a prerequisite is a microscope which combines ultra-high vacuum (UHV) with surface science cleaning and characterization techniques such as ion beam sputtering, annealing, and Auger spectroscopy. In order to achieve this, we have mounted onto the side of a UHV-H9000 microscope LEED/Auger, an ion gun, and optical heating; in the transfer chamber specimens can be cleaned at a base pressure of 2×10^{-10} torr and transferred into the microscope which operates at pressures better than 2×10^{-10} torr. With this marriage, it is relatively simple to prepare and characterize clean surfaces.

As an example, thin gold film specimens, textured with the [111] normal to the film, were made in a standard vacuum evaporator and floated onto a gold grid. The transfer chamber was then baked-out at 250°C for about 12 hours to achieve UHV conditions. Figure 1 shows an image taken from the gold film after bakeout. It is apparent from the image that a few layers of graphitic carbon is present on the surface. This is also apparent in the Auger spectra obtained by means of the LEED optics. To remove the contamination layers, the gold film was cleaned by 1 keV argon ions aligned at 45° to the film normal for 15 minutes. After a week in the UHV microscope, and a room temperature anneal, the gold surfaces reconstruct[1]. Figure 2 is a bright field image taken from a grain of the gold thin film showing the reconstructed surface. Figure 3 is a dark field image using the g_{220} diffracted spot to obtain the image. Note that the fringes evident in the image are perpendicular to the [220] direction.

These results, and more recent results on other surfaces will be described in detail.

References

1. L.D. Marks et al., Submitted to Physical Review Letters.
2. This work was sponsored by the Air Force Office of Scientific Research, the Department of Energy, and the National Science Foundation.

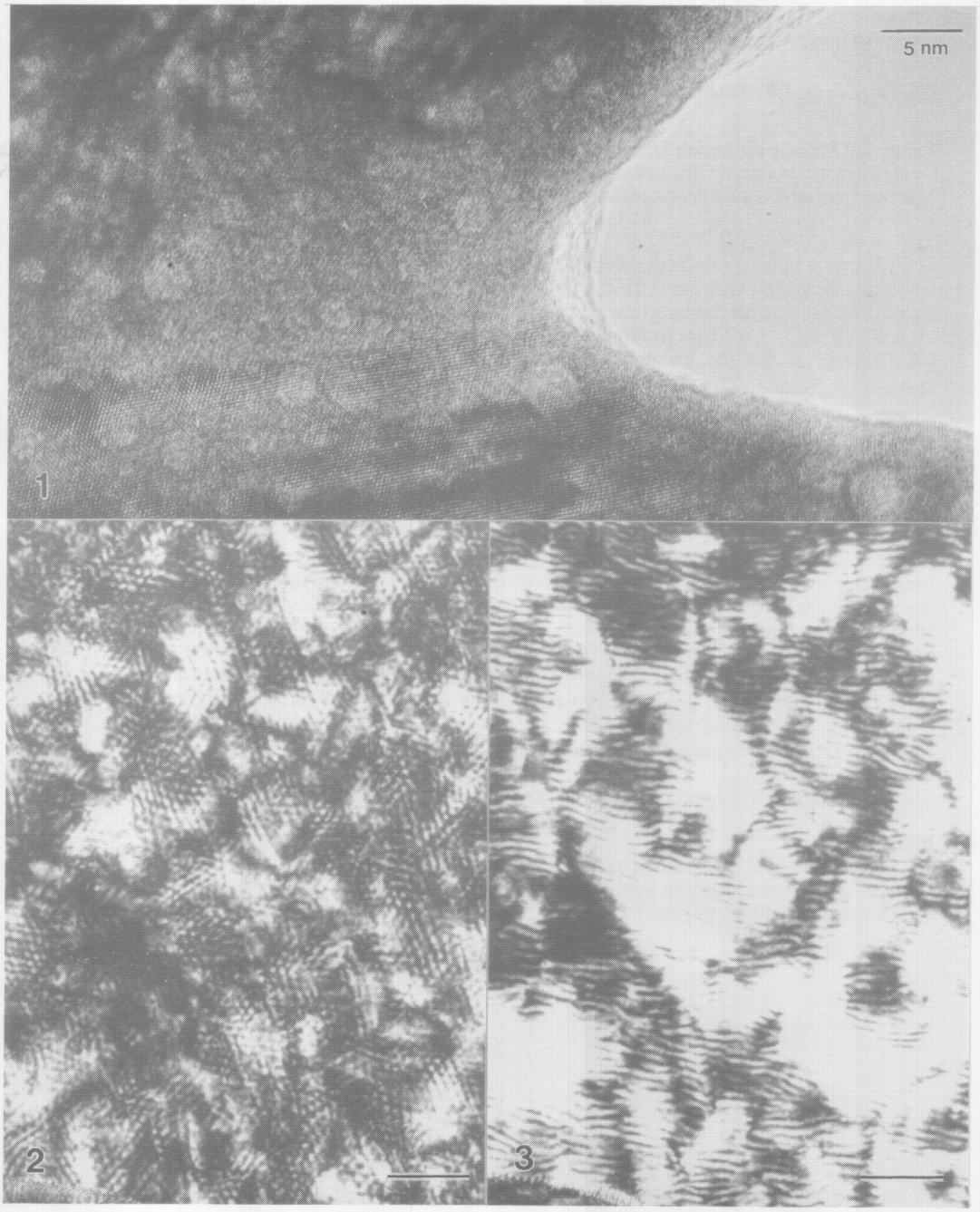

FIG 1.--High resolution image of gold thin film showing carboneous material. Bar=50Å.
FIG 2.--Bright-field image of single grain of gold film. Note Moire fringes delinating different regions of reconstructed surface. Bar=130 Å.
FIG 3.--Dark-field image of same grain as in FIG. 2 using g_{220} diffracted spot. Note that Moire fringes are perpendicular to [220] direction of image. Bar=130 Å.