

Chemical Effects on Electrical Resistivity in Nanoscale Metal Films

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The FRAC award, supplemented by other funds, enabled doctoral student Ms. Chang Liu to devote herself full time to research into the changes in electrical resistance induced by surface-bonded molecules on thin copper films. She was able to carry out and analyze extensive experiments on two different phenomena, both yielding novel results that we plan to publish within the next 1-2 years, and that will form a significant portion of her dissertation. We greatly appreciate the support from FRAC, which was invaluable in facilitating both the research and Ms. Liu's graduate education.

In a study of the surface resistivity induced by carbon monoxide (CO), Ms. Liu determined that molecules bonded to different sites on the surface make different contributions to the resistivity. In particular, molecules bonded to defects in the otherwise smooth surface make a negligible contribution compared to those bonded to sites on the atomically smooth regions of the surface. While such differences between sites are not entirely unexpected, they have not previously been detected. Ms. Liu presented a poster on these results at the National Symposium of the American Vacuum Society, and we are now beginning work on a paper reporting these results.

Ms. Liu also performed experiments on interactions between oxygen and sulfur atoms on the surface. She found that a small amount of sulfur has no effect on the resistivity due to subsequently deposited oxygen when the amount of that oxygen is small, but suppresses the oxygen-induced resistivity at higher oxygen concentrations. We speculate that this effect is due to a short-range interaction between the two species, and that when the amounts of oxygen and sulfur are low, the molecules are separated by too great a distance for the effect to occur. Additional experiments and modeling are needed to confirm or refine both the observations and the explanation.

A proposal has been submitted to the Petroleum Research Fund, administered by the American Chemical Society, for continuing support of Ms. Liu's research.

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