IV. PHOTOEMISSION SPECTROSCOPY

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1. ANGLE-RESOLVED PHOTOEMISSION SPECTROSCOPY

Joint Services Electronics Program (Contract DAAG29-78-C-0020)

F. Read McFeely, Michael R. McClellan, Michael J. Sayers

During the past few years we have been working to develop a highly sensitive versatile instrument to perform electron-spectroscopic experiments on surfaces. This work has been substantially completed. The instrument we have constructed is based around a 180-degree spherical-sector electrostatic electron-energy analyzer capable of rotating 360 degrees in a horizontal plane and 100 degrees in a vertical plane, thus enabling us to perform angle-resolved electron-spectroscopic measurements of all types. In addition, the incorporation of an efficient input lens system provides us with a very large accessible range of electron energies we can analyze with high transmission, thus allowing us to use the same energy analyzer in conjunction with excitation sources ranging from 2 keV down to 1 eV.

Our primary experimental effort in the coming year will be to use this system to study the orientational effect of the surface upon adsorbed molecules via angle-resolved ultraviolet photoemission spectroscopy. In order to perform these experiments in an optimum fashion polarized photons are required. In the past year we have built and tested a rotatable UV polarizer which has given us roughly 50% of theoretical intensity for He II photons generated in a discharge lamp. The use of a multichannel electron detector (currently installed in the system and being tested) will provide for us the increased sensitivity necessary to do these experiments with the reduced polarized photon flux.

2. ELECTRON-ENERGY LOSS SPECTROSCOPY

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In addition to the completion of our energy-analysis system, we have also designed and constructed an electron monochromator, for performing high-resolution electron-energy loss experiments. These experiments will allow us to elucidate the vibrational properties of the molecules of the surface. We will be able to perform these experiments simultaneously with the angle-resolved photoemission experiments. At the present time this monochromator can produce a beam of usable intensity with approximately thirty-meV resolution. While we plan on a substantial effort to improve this to approximately 10 meV in the coming year, this beam is already useful for studying higher frequency vibrations, and, in particular, the study of large-momentum transfer scattering.