

IV. PHOTOEMISSION SPECTROSCOPY

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During the past year our research effort has been focused on two distinct projects. The first of these was a completion of our investigation of the structural surface chemistry of the CO-ZnO system. The second of these consisted of preparations for the study of halogen-(group IV) and halogen-(III-V) surface reactions, which will constitute the major portion of our research in the coming year.

Our work on the structure of CO adsorbed on ZnO followed from our initial angle-resolved photoemission (ARPES) investigation of the nonpolar $(10\bar{1}0)$ surface. This experiment [Chem. Phys. Lett. 75, 575 (1980)] showed that the CO molecule was bound primarily to surface zinc ions; however, the deviation observed from the ideal linear Zn-C-O geometry was indicative of some interaction with surface oxygen. This result left the nature of the requirement for CO binding to ZnO in doubt: either the zinc ion alone is sufficient or instead, both a coordinatively unsaturated zinc and oxygen could be necessary.

This distinction has important consequences for the nature of adsorption on polar ZnO surfaces, which may be either zinc- or oxygen-terminated. As heats of adsorption on these two surfaces are identical to that for CO on $(10\bar{1}0)$, it was thought that defects could be responsible for adsorption on one or both of these crystal faces. Detailed ARPES experiments on both of these faces showed that the zinc ion is the sole requirement for adsorption and that defect-dominated adsorption occurs only on the oxygen-terminated surfaces.

In order to pursue our experiments on halogen surface reactions, we have

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constructed two new experimental systems during the past year. The first of these is a high-resolution electron-energy-loss spectrometer, which will be used to probe the vibrational properties of the halogenated surface. The second is a vacuum-interlocked chamber which will allow us to study the effects of high halogen pressures. These experiments will commence shortly.