Adsorption and Adhesion Energies of Metals on Polymers.

Metal / polymer interfaces are used in many materials applications and in microelectronics, device packaging and protective coatings [33-35]. Electronic and optoelectronic devices based on organic semiconductors (e.g., light emitting diodes and related displays, lasers, and microelectronics) hold great promise because of the tailorizability and processing advantages of conjugated polymers [34-37]. Reactions at the metal / polymer interface or adhesion can determine whether a device works or fails. Also, the metal's adsorption energy and its dependence on coverage (particle diameter, thickness) must to some extent determine metal thin film growth morphology when deposited on a polymer. However, little of a fundamental nature is understood about the energetics involved, which provide the thermodynamic driving forces underlying these interfacial reactions and morphological properties.

We propose to demonstrate the feasibility of the measurement of adsorption and adhesion energies of metals on polymers using the adsorption calorimetry approach described for metals on oxides above (see Prior Results). Polymers require no sputtering and little or no annealing in order to get clean surfaces when introduced properly into UHV [38-42], so they can be mounted directly against the β-PVDF detector film upon insertion into the vacuum chamber, or they can even be spin-coated directly onto this β-PVDF pyroelectric film. The sensitivity is much higher in these geometries. In collaboration with Prof. Buddy Ratner and David Castner's groups in our Chemical Engineering Department, who have great expertise in this method for preparing clean polymer surfaces, we will spin-coat films of polyisobutylene, polystyrene and polymethylmethacrylate onto the PVDF for this study. In this way we will study Cu and Ag adsorption onto polymers which should have different types of chemical interactions with the metal: a low-interaction alkane control, a system offering delocalized p levels with C=C double bonds, and a system with more complex organic functionality involving heteroatoms. Electron beam damage and sputter roughening are often used to improve metal adhesion to polymer surfaces. The influence of these on adhesion and adsorption energies, and on metal sticking probabilities, will also be investigated.

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