Electrostatic Electrochemistry with Polymers Charged by Contact Electrification

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***Abstract*— Surfaces of dielectrics (insulators) often become charged following contact with metals, semiconductors, and dielectrics with or without rubbing. The identity of charges generated by contact electrification has remained controversial for centuries and the precise determination of the charge density is also a long-standing challenge. A main experimental obstacle is that conventional electrostatic measurement with an electronic probe or faraday cup is unable to distinguish electronic from ionic charge. We have recently found that charges on a dielectric surface, e.g. for polymers like Teflon (polytetrafluoroethylene or PTFE), polyethylene (PE), [poly(methylmethacrylate) or (PMMA)] and polyamide (Nylon), can carry out different chemical redox reactions e.g. hydrogen formation; metal deposition; ion reduction; and chemiluminescence.[1-4] This suggests that electron rather than or in addition to ion transfer occurs in contact electrification. Moreover, such a chemical approach allows determination of the surface density of electronic charge based on Faraday's law. Note that there is an important distinction between sensing the electrons on a dielectric surface with a chemical approach compared to conventional physical methods of measuring charge. When the surface electrons are compensated partially or fully with physically adsorbed ions such as Na+, the electrostatic measurement finds the overall charge (electronic plus ionic), while the chemical technique is able to selectively detect only the electronic charge on the surface, independent of the counter ions. Therefore, an electron density determined by chemical measurement is likely to be higher than the one obtained with conventional physical technique, depending on the degree of compensation.**

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