

Comments on the concept of crypto-electrons on dielectric surfaces

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Abstract— Recent reports in the literature claimed that Teflon and Polyethylene charged by rubbing with either Polymethylmethacrylate (PMMA) or Nylon and, similarly, spontaneously charged purge PMMA and pure Nylon induce a variety of “redox” reactions, including those of Pd²⁺ and Cu²⁺ ions. On the basis of these findings it was concluded that these polymers are charged spontaneously by electrons, defined as “crypto-electrons”. The concentration of the latter was estimated as high as $>10^{13}$ - 10^{14} electrons/cm². X-ray photoelectron spectroscopy (XPS), infrared spectroscopy (IR), contact angle and vibrating electrometer (modified Kelvin probe) measurements show, however, that the surface charge created on the above dielectric polymers does not reduce Cu²⁺ and Pd²⁺ ions. Instead, rubbing of polymers causes material exchange, accompanied by transfer of polar active species (containing >C=O groups), which promotes adsorption of Cu²⁺ and Pd²⁺ ions. Surface coverage of 10-30% of Cu²⁺ and 1-5% of Pd²⁺ of monolayer can be achieved by adsorption from the dilute aqueous solutions. Furthermore, Pd²⁺ ions, which are reduced to Pd⁰ by the formaldehyde within the copper bath, and not by the crypto-electrons as proposed before, induce the reduction of Cu²⁺ to Cu⁰ and the ensuing plating of the dielectric polymers by copper. On the base of these studies, we challenge the hypothesis of charging dielectrics by “cryptoelectrons” and support the view that these surfaces are charged presumably by uncompensated ions.