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Title: Spectroscopic methods of Charge Detection on Nanoparticles and Surface Structures

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Abstract:

A novel technique is introduced for probing charging/discharging dynamics of dielectric materials, in which X-ray photoemission data is recorded while the sample rod is subjected to ±10.0 V square-wave pulses with varying frequencies in the range of 10-3 to 103 Hz. This technique allows us to probe electrical impedance of dielectric materials. Accordingly, for a clean silicon sample the Si2p(Si0) peak appears at correspondingly -10.0 eV and +10.0 eV binding energy positions (20.0 eV difference) with no frequency dependence. However, the corresponding peak of the oxide (Si4+) appears with less than 20.0 eV difference and exhibits a strong frequency dependence due to charging of the oxide layer, which is faithfully reproduced by a theoretical model. Different dielectric information can be obtained from the frequency dependence of the positions, as well as the widths of the peaks. Various applications of this technique for characterization of organic (polymeric) and inorganic homogeneous and heterogeneous materials and surface structures will be presented and discussed.