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Far-Infrared Studies of Electrochemically Oxidized Metals

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Catalytic properties of Pt and Ru oxides are of considerable importance due to their possible use in fuel cells for electrochemically-powered vehicles. Despite the sizeable progress in their characterization by FTIR, very little work has been done in the far-infrared region, primarily due to a limited power of the globar source in this frequency region. The nature of synchrotron radiation that is three orders of magnitude brighter than that of globar source is utilized in this study. A fully-grown oxide layer has been investigated first ex-situ with the IR microscope, and the characteristic frequencies of Pt-O and Ru-O, as well as their dependence on various electrochemical parameters including solution composition, concentration and applied potential were observed. Catalytic properties of these metal oxides on CO oxidation were also investigated. The in-situ characterization of the oxides while they are formed also strongly depends on the power of the synchrotron beam to penetrate the IR-opaque electrochemical aqueous solution layer and irradiate the metal surface. In addition, highly horizontally polarized synchrotron beam eliminates the need of IR polarizer. The current work involves investigation of the potentially controlled oxide layer using a specially constructed electrochemical cell described earlier (see scientific subproject #39, 2001). Combining the IR results with other techniques, including XAS, important questions on the nature and the catalytic properties of these oxides will be addressed.