

Spectroelectrochemical Studies of Proteins Using Boron-Doped Diamond Optically Transparent Electrodes.

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This presentation will discuss the fabrication, characterization and use of boron-doped diamond (BDD) as an optically transparent electrode (OTE). Conductive diamond films (~1 μ m) deposited on quartz or undoped Si, and free standing diamond disks (~350 μ m) are suitable OTEs (40-60 %T) for transmission spectroelectrochemical measurements in the UV/vis and IR regions of the electromagnetic spectrum. BDD is highly conductive, possesses a wide working potential window, and exhibits good electrochemical responsiveness for a variety of redox systems.¹ As an optical material, diamond is mechanically strong and able to transmit from the visible down to the far IR region of the spectrum. Zak, et al have demonstrated the usefulness of a free standing diamond OTE for ferri/ferrocyanide and methyl viologen measurements in the UV/vis region.² BDD OTEs have also proven useful for UV/vis and IR investigations of the non-aqueous system ferrocene.³

We will present our efforts to extend the application of this OTE material into the far infrared region as well as demonstrate its usefulness towards protein measurements. Our approach has three facets: (i) determining optimal surface conditions for facile protein electrochemistry at BDD, (ii) assessing the usefulness of different types of BDD OTEs and (iii) developing a working cell design for measurements in the UV/vis and IR regions. We are primarily interested in the far IR (<1000 cm^{-1}) region of the spectrum. Our goal is to access this region and identify redox-dependent vibrations that arise from metal-ligand modes in redox-active metalloenzymes and bioinorganic model compounds. The initial protein system under investigation is cytochrome c.

1. Granger, M.C., Witek, M., Xu, J., Wang, J., Hupert, M., Hanks, A., Koppang, M.D., Butler, J.E., Lucazeau, G., Mermoux, M., Strojek, J.W., Swain, G.M. *Anal. Chem.*, 72, 3793 (2000).
2. Zak, J.K., Butler, J.E., Swain, G.M. *Anal. Chem.*, 73, 908-914 (2001).
3. Haymond, S., Zak, J.K., Butler, J.E., Babcock, G.T., Swain, G.M. *in preparation*.