

Supporting Information for

Electrical Bias-Dependent Photochemical Functionalization of Diamond Surfaces

Beth M. Nichols,[†] Kevin M. Metz,[†] Kiu-Yuen Tse,[†] James E. Butler,[‡] John N. Russell, Jr.,[‡]
and Robert J. Hamers^{†*}

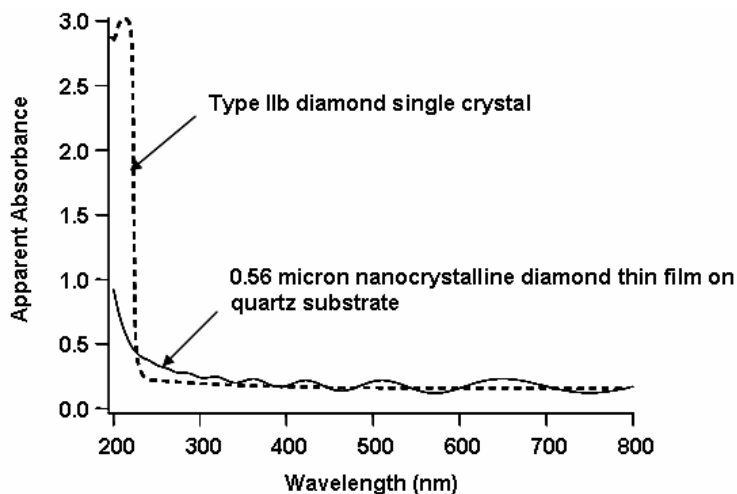
[†]Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706; [‡]Surface Chemistry Branch, Code 6170, Naval Research Laboratory, 4555 Overlook Avenue, SW, Washington, DC 20375

*Corresponding Author: rjhamers@wisc.edu

The spectra below show the IV-visible transmission spectra of two different diamond samples. The dashed line shows data obtained on a 0.25 millimeter thick type IIb (lightly boron-doped) natural (111)-oriented diamond sample. The solid line is the apparent absorbance of a 0.56 micron-thick diamond film on a quartz substrate, identical to the samples used in the current manuscript.

At long wavelengths the apparent absorption is dominated by the reflectivity of diamond. The index of refraction of diamond varies from 2.411 at 650 nm to 2.62 near 254 nm.¹ In a simple transmission experiment through a sample of bulk diamond and neglecting interference effects, this causes a reflectivity loss of 8% to 10.4% per surface, resulting in an *apparent* absorbance of 0.17 (at 650 nm) to approximately 0.24 (near 254 nm).

For a diamond thin film on a transparent substrate, the situation is complicated by interference effects and by the fact that diamond films typically have a high density of small nuclei where growth initiates, followed by coalescence and formation of larger crystallites as the film thickness increases. Consequently, the optical properties within a diamond film are likely to be inhomogeneous.



In the spectra above, the dashed line shows the apparent absorbance of a single-crystal type IIb diamond. At wavelength longer than 225 nm, the apparent absorbance of this sample agrees very closely with the expected reflectivity loss, indicating that the apparent absorbance is almost exclusively reflection losses, and there is little or no significant true absorption at 254 nm. The solid line shows the apparent absorbance of the 0.56 micron-thick diamond film, on a quartz substrate, used in the current manuscript.

The thin-film sample shows clear interference effects. At 254 nm, the difference in apparent absorbance between the diamond thin film and the single-crystal diamond is 0.1 absorbance unit, corresponding to a loss of <20% of the intensity at this wavelength in passing through the film. This likely represents a good estimate of the actual optical absorption within the diamond thin film.

1) D.F. Edwards and H.R. Philipp, in "Handbook of Optical Constants of Solids", E. Palik, Ed., Academic Press, 1985.