Responsivities of Silicon Photodiode Detectors with Bandpass Filter Coatings for 1.7-15 nm

J. Seely (NRL)

Abstract No. seel4708
Beamline(s): **X24C**

An optical model was developed for the responsivity, the current in the external circuit divided by the incident radiation power, of silicon photodiode detectors with filter coatings. The coatings were composed of thin layers of metals and other materials and were designed to provide bandpasses in the 1.7-15 nm wavelength range. The responsivity model solved the boundary value problem of an electromagnetic field propagating through the layers of the coating and the underlying photodiode regions. The model accounted for the optical properties of each layer, the reflectance and transmittance at the boundaries, and the attenuation of the field strength in the layers. The responsivities of the coated photodiodes were calculated based on the energy deposition and the carrier collection efficiency in each coating layer and photodiode region. Detectors with eight different filter coatings were characterized using synchrotron radiation. By comparing the currents from coated and uncoated photodiodes, the transmittances of the coatings were determined and were in good agreement with the calculated transmittances. The optical model was used to determine the responsivities of the filtered photodiodes in the 1.7 nm to 15 nm wavelength range.