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Temperature-Dependent Cathodoluminescence of Disordered SiO2 Layers[1] AMBERLY E. JENSEN, JR DENNISON, GREGORY WILSON, JUSTIN DEKANY, USU Materials Physics Group — Optical coatings of disordered thin film SiO2/SiOx dielectric samples on reflective metal substrates exhibited electron-induced luminescence (cathodoluminescence) under electron beam irradiation. These experiments provided measurements of the absolute radiance and emission spectra as functions of incident electron energy, flux and power over a range of sample temperatures (<40 K to >300 K). The overall luminescent intensity increased linearly with increasing power, plateaued, then fell off approximately exponentially. Spectrometer data revealed four spectral bands. The structural defects associated with three of the four bands have been identified. Temperature dependence of the peak intensity and central position differs for the lower and higher energy bands. These results are interpreted with a model of the band structure of highly disordered trapped states within the band gap of SiO2, used to describe the excitation of electrons from the valence band to the conduction band and subsequent relaxation into trapped states. The cathodoluminescence model describes these experimental observations, providing a fundamental basis for understanding the dependence of cathodoluminescence on irradiation time and accumulated charge, incident flux and energy, and sample thickness and temperature.

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