

Measuring pulse energy with solid state photodiodes

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Abstract. With the advent of extreme ultraviolet lithography (EUVL) the measurement of the energy contained in pulses of short-wavelength radiation is becoming increasingly important. Even low average power sources can deliver pulses of radiation with high peak power to a photodiode. For example, a 150 W EUVL production source operating at 10 kHz and 100 ns pulse length delivers a peak power of 150 kW to the detector, easily enough to drive the detector into saturation. Recently, we have reported on the non-linearity of the responsivity of Si photodiodes under pulsed illumination and developed a model that predicts the observed saturation behavior, including the dependence on reverse bias. Here we extend the characterization of solid-state photodiodes from 8 ns pulses to pulse lengths of 1 μ m and examine the effect of power density (illumination area) on the saturation behavior. The model we developed has been used to validate the calibration in pulsed radiation of an EUVL source diagnostic instrument by comparison to a calibration under cw conditions at a synchrotron.