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Silicon Nanocrystal Internal Quantum Efficiency via Local Optical Density of States ROBB WALTERS, Caltech, HARRY ATWATER, Caltech, MIHEIL DE DOOD, UCSB, JEROEN KALKMAN, FOM-AMOLF, ALBERT POLMAN, FOM-AMOLF — The radiative rate of a dipole emitter is proportional to the local density of optical states (LDOS) at the physical location of the dipole in the approximation of Fermi's Golden Rule. We have measured the decay rate of silicon nanocrystals as a function of the LDOS while holding the non-radiative rate constant. The data are fit to a model to derive the internal quantum efficiency for silicon nanocrystals embedded in an oxide matrix. Nanocrystals are prepared by ion implantation into oxide at low energy (5keV) and subsequent thermal annealing (1100C). This procedure creates 2-4nm diameter silicon nanocrystals near the projected implantation range of 10nm from the oxide surface. Different oxide thicknesses are created on the same sample by etching back a thick oxide to form a "staircase" structure prior to implantation. This ensures that the nanocrystal populations are created through identical processing. The LDOS is calculated as a function of the distance from the nanocrystals to the high index silicon substrate. Due to the variation in the LDOS, we measure decay rates that vary from 10 to 50 kHz. The implications of our experiment on the prospects of silicon nanocrystals as an optical material will be discussed.

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