Controlling Energy Transfer in Silicon Quantum Dot Assemblies Made from All-Inorganic Colloidal Silicon Quantum Dots

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Estimation of thickness by ellipsometry

The thicknesses of LbL assemblies of Si QDs are measured by spectroscopic ellipsometer (Auto-SE, Horiba) in the wavelength range of 450 to 1000 nm. The sample is deposited on APTES modified Si wafers with native oxides. The thickness of APTES and native oxides are 2.7 and 0.9 nm, respectively. We assume that the dielectric medium consisting of a Si QD layer (ε_{eff}) is obtained by the Bruggeman effective medium approximation,[1]

$$f_{Si}\frac{\varepsilon_{Si}-\varepsilon_{eff}}{\varepsilon_{Si}+2\varepsilon_{eff}}+(1-f_{Si})\frac{\varepsilon_{air}-\varepsilon_{eff}}{\varepsilon_{air}+2\varepsilon_{eff}}=0 \ ,$$

where ε_{Si} and f_{Si} are the dielectric permittivity and filling factor of Si and ε_{air} is the dielectric permittivity of air. Figure S3 shows the thickness of D-(3.0)$_N$ with filling factor range of 0.25 to 0.35.

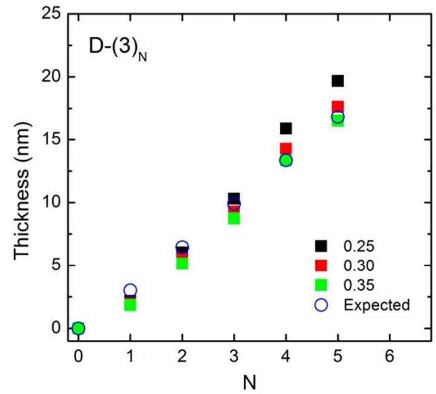

Figure S1. (Filled squares) Thicknesses of D-(3.0)$_N$ obtained by ellipsometry with the filling factor range of 0.25 to 0.35 The data shown as open circles represent the expected thickness of LbL layers of 3 nm Si QDs and 0.45 nm PDDA layers.

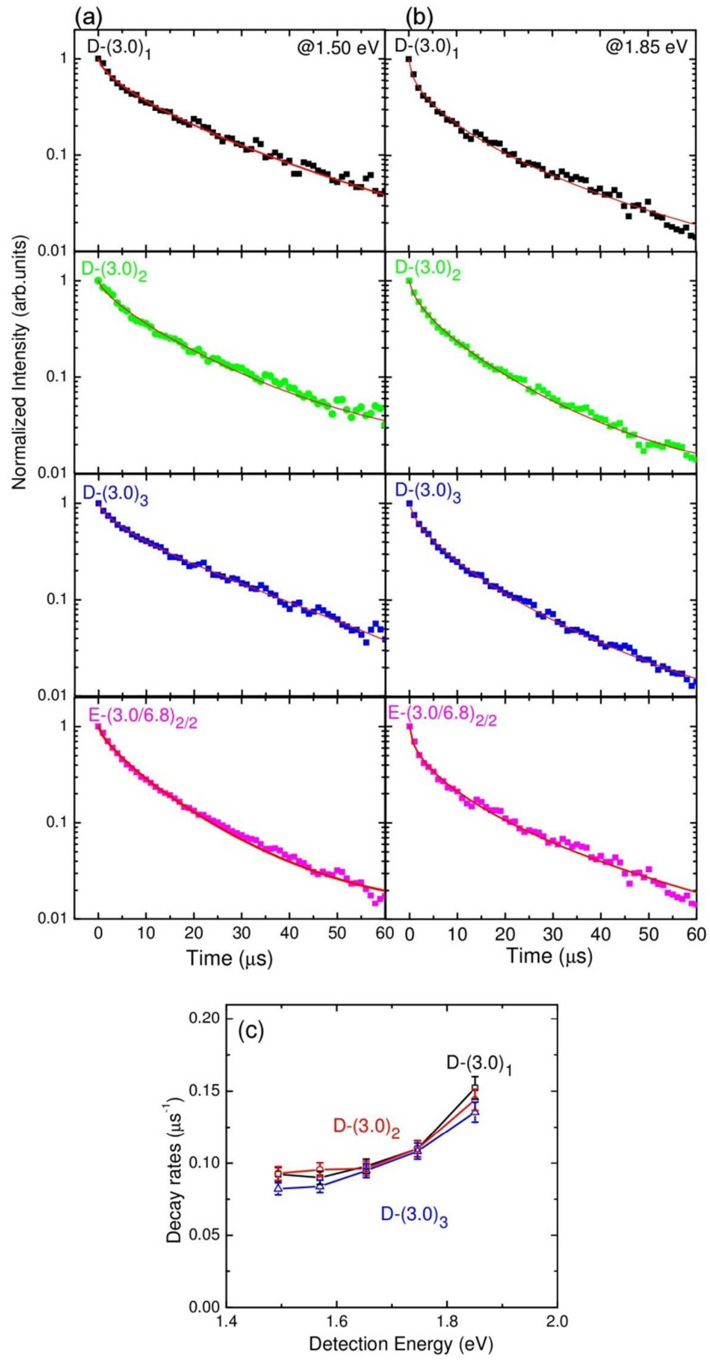

Figure S2. PL decay curves detected at (a) 1.5 and (b) 1.85 eV of D-$(3.0)_1$, D-$(3.0)_2$, D-$(3.0)_3$ and E-$(3.0/6.8)_{2/2}$ with corresponding stretched exponential fitting results. (c) PL decay rates of D-$(3.0)_1$, D-$(3.0)_2$, D-$(3.0)_3$ as a function of detection energy.

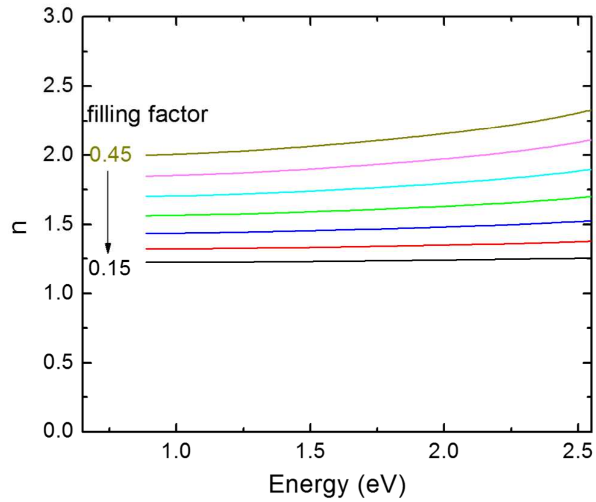

Figure S3. The refractive index as a function of photon energy obtained by the Bruggeman effective medium model with different filling factors of Si QDs.

Reference

(1) Bruggeman, D. A. G. Calculation of Various Physics Constants in Heterogenous Substances I Dielectricity Constants and Conductivity of Mixed Bodies from Isotropic Substances. *Ann. Phys*. **1935**, 24, 636– 664.