"PROBING THE PHOTOPHYSICS AND EXCITON DYNAMICS WITHIN SEMICONDUCTOR QUANTUM WIRES"

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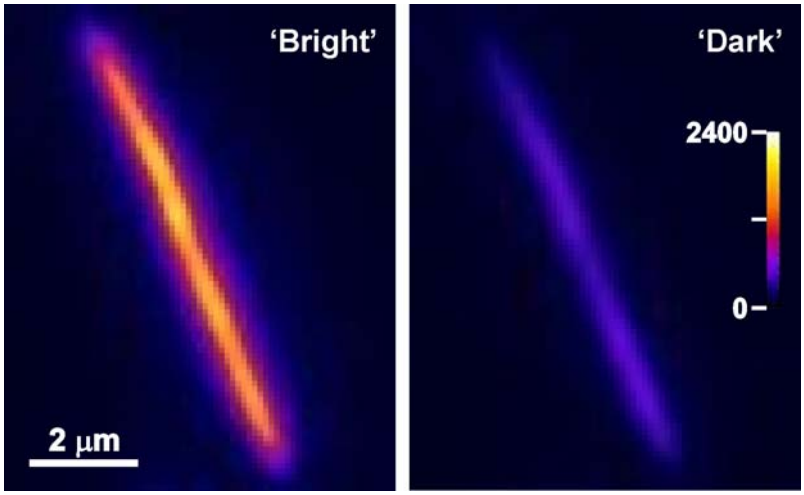
We are currently using single-molecule optical microscopy methods to investigate the photophysics within single semiconductor quantum wires (QWs). Most investigations have focused on CdSe single-crystalline nanostructures with diameters as small as 3.5 nm and lengths as long as 100 μm. In these efforts, we have detected fluctuations in the intensity of the photoluminescence (PL) along entire CdSe QWs under continuous illumination. While similar PL blinking has been reported previously for semiconductor quantum dots and rods, the observation of this synchronous blinking spanning the entire length of a QW is novel. We propose that a photo-induced, kinetic charge trapping mechanism gives rise to the synchronous PL intensity fluctuations observed in these QWs. We have also observed PL emission from multi-exciton states when exciting with high excitation densities. State filling of these multi-exciton states occurs on fast timescales, and radiative emission efficiently competes with non-radiative relaxation so that emission is observed on timescales >100 ps. PL experiments on single QWs are also performed at varying temperatures. At low temperatures, <40 K, energy relaxation of excitons from higher- to lower-energy states is observed. Similar experiments are now ongoing on other QWs, including CdTe, PbSe, and InP.



Photoluminescence blinking of a single CdSe QW at room temperature. The blinking is attributed to the non-statistical filling and emptying of surface exciton trap sites.