Individual Quantum Dots: Slow-Light Polaritons and Energy Transfer Dynamics

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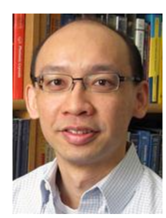
Abstract: Cavity quantum electrodynamics advances the coherent control of a single quantum emitter with a quantized radiation field mode, typically piecewise engineered for the highest finesse and confinement in the cavity field. This enables the possibility of strong coupling, wherein the potential polariton states are cornerstones in entanglement and repeaters in quantum information processing. Achieving such vacuum Rabi splitting in the solid state draws the remarkable potential for chip-scale processing, but till now is limited to several research groups that can achieve the precision and deterministic requirements for these condensed exciton polariton states. In the first part of the talk, we describe the first observations of polariton states of strong coherently coupled single InAs quantum dot excitons in inherently disordered one-dimensional localized modes in slow-light photonic crystals. Large vacuum Rabi splittings up to 311 μeV are observed, one of the largest avoided crossings in the solid-state quantum dots, supported by tight-binding models and quantum dissipative master equations.

In the second part of the talk, we describe the time-resolved resonance energy transfer of excitons from single *n*-butyl amine-bound, chloride-terminated CdSe nanocrystals to two-dimensional graphene through time-correlated single photon counting. The radiative biexponential lifetime kinetics and blinking statistics of the individual surface-modified nanocrystal elucidate the non-radiative decay channels. Blinking modification as well as a remarkable 4-fold reduction in spontaneous emission were observed with the short chloride and *n*-butylamine ligands, probing the energy transfer pathways towards next-generation thin-film photovoltaics.

Biography: Chee Wei Wong advances the control of light in mesoscopic systems, focusing on nonlinear, ultrafast, quantum and precision measurements. He received the Doctorate of Science in 2003 and the Masters of Science in 2001, both from the Massachusetts Institute of Technology. From 1996 to 1999, he completed his double degree, B.Sc. highest distinction and B.A. highest distinction, both from the University of California at Berkeley.



He is the recipient of the 2009 3M Faculty Award, the 2008 NSF CAREER Award, and the 2007 DARPA Young Faculty Award. Since 2004 he is affiliated with Columbia University, and he has published 65+ journal articles, 100+ conference articles, 4 book chapters, received 10 awarded patents, and delivered 60+ invited talks at universities and industry. In his spare time, he enjoys playing the piano, running, and snowboarding. His work has appeared in Nature, Nature Photonics, Nature Scientific Reports, Physical Review Letters, Nano Letters amongst others.