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New Fundamental Optical Behaviors of Single-Wall Carbon Nanotubes at Cryogenic Temperatures: Closer to their Intrinsic Behavior[1]
JUAN DUQUE, CHRISTOPHER HAMILTON, JARED CROCHET, ANDREW DATTELBAUM, SCOTT CROOKER, STEPHEN DOORN, Los Alamos National lab — Development of single walled carbon nanotube (SWNT) materials for optoelectronics and nanophotonics has been especially challenging in that SWNT optical properties are highly sensitive to environmental interactions, which can be particularly severe in composite matrices. Here, we present for the first time an innovative approach to obtain highly photoluminescent (PL) solid-state SWNT-nanocomposites, which provides access to novel photophysical properties. Strongly blue-shifted spectral features, and significant increase ($\sim$ 3x) in PL intensities at croyogenic temp in comparison to room tem or previous reports. This difference can be understood as arising from a significantly slower relaxation of excitons from bright to dark states in our SWNTs, as a result of much weaker interaction with the environment. That is, the bright/dark exciton distribution is highly non-thermal, even at the lowest temperatures. In our SWNT-nanocomposites, environmental interactions are minimized, thus bright excitons *cannot* relax efficiently to the dark state, causing a highly non-equilibrium exciton distribution and a correspondingly large PL intensity, even at low temperatures.

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