UCLA Chemistry & Biochemistry

Physical Chemistry Seminar

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Chemical Design of Optoelectronic Point Defects in Nanoscale Ceramic Materials

Designing point defects within nanoscale materials remains an active area for both basic and applied research. This seminar will present recent results with designing specific point defects in both 1) nanodiamond aerogel (NV^-, $Si\text{-}V^-$) and 2) yttrium-lithium-fluoride nanocrystals (Yb^{3+}, Er^{3+}). In the first half of the seminar high-pressure, high-temperature processing in a laser-heated diamond anvil cell [PNAS (2011), v.108 p.8550] will be presented as a promising strategy for creating both the nitrogen-vacancy center and silicon di-vacancy center within nanocrystalline diamond materials. In the second half of the seminar recent results [PNAS (2015), v.112, p. 15024] will be presented showing that it is possible to cool colloidal dispersions of yttrium-lithium-fluoride nanocrystals ($YLiF_4$ or YLF) in liquid water based on anti-Stokes photoluminescence from Yb^{3+} point defects. Solid-state laser-refrigeration materials have been developed in the last 10 years that are capable of cooling to cryogenic temperatures without mechanical vibrations to enable a range of advanced optoelectronic sensing applications. However, to date it has remained an open question whether solid-state laser refrigeration materials can also be used to refrigerate condensed phases such as liquid water. We use single-beam laser trapping experiments to show that the temperature of water surrounding individual YLF crystals decreases by nearly 20°C from room temperature based on interferometric measurements of a particle's Brownian motion, suggesting a range of potential applications for solid-state laser-refrigeration at nanometer length scales.

Monday, May 2, 2016
4:00 P.M.
2033 Young Hall

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