New research expected to improve laser devices and make photovoltaics more efficient

November 13 2008

(PhysOrg.com) -- University of Chicago scientists have induced electrons in the nanocrystals of semiconductors to cool more slowly by forcing them into a smaller volume. This has the potential to improve satellite communications and the generation of solar power.

"Slowing down the cooling of these electrons—in this case, by more than 30 times—could lead to a better infrared laser source," said Philippe Guyot-Sionnest, Professor of Chemistry and Physics at the University of Chicago. "This, in turn, could be used to increase the bandwidth of communication satellites, allowing for faster connections."

Guyot-Sionnest is the principal investigator on the research project, which was described in a paper called "Slow Electron Cooling in Colloidal Quantum Dots," published Nov. 7 in *Science*.

The slow cooling of electrons in nanocrystals could lead to better, more efficient photovoltaic devices, he added. "This is because proposals to devise ways to extract the excess heat from these electrons as they cool are more likely to be realized—and to work—due to the fact that we now understand better what is going on with these nanocrystals."

Slower cooling of electrons in nanocrystals was first theorized in 1990, but no one has been able to observe this effect.

Slow electron cooling in nanocrystals occurs because forcing the electrons into a smaller volume leads them to oscillate between their alternate extremes within a very short period of time. (This is analogous to the way shorter strings on musical instruments produce higher pitches.) The electrons in the nanocrystals used in this experiment oscillated so fast that it became difficult for them to drag along the more sluggish vibrations of the nuclei. As a result, the energy stayed with the electrons for a longer period of time.

The slower cooling effect was difficult to induce and observe because several different mechanisms for energy loss interfered with the process. By eliminating these other mechanisms, the researchers were able to induce and observe slower electron cooling in nanocrystals.

Provided by University of Chicago