

Physics Colloquium

Michigan Technological University

November 9, (Thursday) 2006, 11:00am
(note: time is different from our normal 4:00pm)
Room 132, Fisher Hall
(also note: different room from 139 Fisher)

Doping Semiconductor Nanocrystals

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Abstract

Doping -- the intentional introduction of impurities into a material-- is fundamental to controlling the properties of bulk semiconductors. The prospect of new technologies has motivated similar efforts to dope semiconductor nanocrystals since their discovery two decades ago. Despite some successes, many of these efforts have failed, for reasons that remain mysterious. For example, individual Mn atoms can be incorporated into nanocrystals of CdS and ZnSe, but not into CdSe - - despite comparable solubility limits near 50 percent in the bulk crystals. These difficulties have hindered the development of important new materials, including p- and n-type, and even magnetic, nanocrystals. Such failures have often been attributed to "self-purification," an allegedly intrinsic mechanism in nanocrystals whereby impurities are expelled to the nearby surface. Here we propose a very different view: that doping is controlled instead by the initial adsorption of impurities on the nanocrystal surface during growth. This idea has enabled us to incorporate individual Mn impurities into previously undopable CdSe nanocrystals. This establishes that earlier difficulties with doping are not intrinsic, and suggests that a variety of doped nanocrystals -- for applications from solar cells to spintronics -- can be anticipated.

Biography

Steve Erwin received his A.B. in Physics from Harvard University in 1982, then temporarily left the East Coast to receive a Ph.D. in Physics from the University of Wisconsin-Madison in 1988. He returned east to the Naval Research Laboratory as a National Research Council postdoctoral associate from 1988-90. From 1990-94 he was a Research Associate in the Department of Physics at the University of Pennsylvania. He returned to NRL in 1994 as a government employee with his own desk and pushbutton telephone. From 1998-99 he was an Alexander von Humboldt research fellow at the Fritz Haber Institute in Berlin.