Nanolasers with Wires and Plasmonic Shells: How Small Can They Be?

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Abstract

The rapid progress of nanoscale science and technology challenges the optoelectronics community to develop ever smaller lasers and other optoelectronic devices compatible with the general technological trend in size reduction. This has led to the lasing demonstration of a single semiconductor nanowire of ~ 100 nanometers in diameter and a few microns in length, or plasmonic lasers with sub-diffraction-limit dimensions. In this talk, I will present many unconventional features of lasers at nanometer scale including smallest size, strong waveguiding, large confinement factor, giant model gain, and world-record wavelength tunability of ~200 nm using nanowires or plasmonic shells. We will show that a metal coated semiconductor core can achieve lasing threshold despite significant metal loss. Our recent experiments on such metal-coated semiconductor wire/pillar structures will be presented, showing examples of smallest lasers ever made and strong evidence of surface-plasmonic lasing. Throughout the talk, I will also try to address the issue of the smallest limit of a nanolaser and show how familiar concepts and principles and understanding of lasers must be modified at nanoscale.

Biography: Cun-Zheng Ning is a Professor of Electrical Engineering and Affiliate Professor of Physics and Materials at Arizona State University. He obtained his PhD in Physics from University of Stuttgart, Germany and was a Research Assistant Professor at University of Arizona till 1997 when he joined NASA Ames Research Center as a Senior Scientist and later as Nanophotonics Group leader and Nanotechnology task manager at NASA Ames Center for Nanotechnology till 2006. He was a ISSP Visiting Professor at University of Tokyo in 2006. He has published over 130 papers and given over 90 invited talks and colloquia. He has served many international conference as Chair or Committee member including those by IEEE (CLEO/IQEC),SPIE, and OSA. He was Associate Editor of IEEE J. Quantum Electronics (2001-2003) and a special topic editor for IEEE J. Special. Topics in Quantum Electron., J. Opt. Soc. Am., Optics Express, etc. For his research at NASA, he has won several NASA and NASA contractors' awards, including NASA Group Achievement award (1999) and CSS Technical Excellence Award (2003). He was recently the recipient of the IEEE Photonics Society (LEOS) Distinguished Lecturer Award for 2007/2008 and 2008/2009.

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