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Beller Lectureship: Surface Plasmon Laser Action Near the Surface Plasmon Frequency

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Lasers have recently been scaled in size beyond the diffraction limit of light by using electromagnetic surface excitations of metals. In this talk, I will discuss our approach to constructing surface plasmon (SP) lasers using semiconductor materials and outline potential applications that exploit the strong interaction of nanoscale light with matter. I will also present recent results on room temperature SPs lasers operating near the SP frequency by utilizing Zinc Oxide as a gain material combined with a Silver substrate. Surface plasmon lasers could be the most efficient and compact method of delivering optical energy to the nanoscale. There are two benefits: firstly, the efficiently generated (focused) coherent laser field can be extremely intense; and secondly, vacuum fluctuations within the laser cavity are considerably stronger than in free space. Consequently, SP lasers have the unique ability to drastically enhance both coherent and incoherent light-matter interactions bringing fundamentally new capabilities to bio-sensing, data storage, photolithography and optical communications. While there is a great deal of research to do on SP laser systems, this talk highlights the feasibility of nano-scale light sources and the potential of laser science at the nanoscale.