MAR17-2016-020147

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Room Temperature Ultralow Threshold Plasmonic Nanolasers with Unusual Scaling Laws

RENMIN MA, Peking University

Plasmonic nanolasers are a new class of quantum amplifiers that deliver coherent surface plasmons well below the diffraction barrier which brings fundamentally new capabilities to biochemical sensing, super-resolution imaging and on-chip optical communication. However, there is always a trade-off between field confinement and metallic absorption loss which has led to a long standing debate about whether metals could eventually enhance the performance of a laser. Particularly at room temperature, plasmonic nanolasers still face extremely high thresholds from MW cm^{-2} up to GW cm^{-2} preventing their practical usage. Here, we report a room temperature plasmonic nanolaser with record low threshold on the order of 10 KW cm^{-2} corresponding to a pump density in the range of modern laser diodes. We find unusual scaling laws that allow plasmonic lasers to be more compact and faster with lower threshold and power consumption than photonic nanolasers when the cavity size approaches or surpasses the diffraction limit. This provides unambiguous evidence that plasmonic lasers have superior performance over photonic laser at the nanoscale. In addition to clarifying this long standing debate, ultralow threshold nanolasers may lead to low-power-consumption nanophotonic circuitry and ultrasensitive biochemical sensors.