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Plasmonic and Photonic Lasers Based on Semiconductor Nanowires: Low-loss and High Mode-tunablity QIHUA XIONG, QING ZHANG, XINFENG LIU, TZECHIEN SUM, School of Physical and Mathematical Sciences, Nanyang Technological University — Understanding the optical gain and mode-selection mechanisms in semiconductor nanowire (NW) based photonic and plasmonic laser is key to the development of high-performance nanoscale oscillators/amplifiers/lasers. Modification of semiconductor band structure through electric field modulation, or alloying semiconductors has so far gained limited success in achieving output mode tunability of the NW laser due to the considerable optical losses. Herein we demonstrate a new optical self-feedback mechanism based on the intrinsic self-absorption of the gain media and plasmonic enhanced Burstein–Moss effect to achieve low-loss photonic and plasmonic lasing with a high degree of mode selectivity (over 30 nm). Moreover, we demonstrate the first room-temperature ultra-violet ($\sim$ 370 nm) plasmonic nanolaser with an extremely-low-threshold ($\sim$ 3.5 MW/cm^2). A closed-contact planar semiconductor-insulator-metal interface greatly lessens the extrinsic cavity loss, and efficiently promotes the exciton-plasmon energy transfer thus furnishes adequate optical gain to compensate the loss. Our straightforward approaches are widely applicable in most semiconductor NW plasmonic/photonic cavities.

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