

Room temperature single-mode plasmonic perovskite nanolasers with sub-picosecond pulses

Taiyuan University of Technology

Guohui Li

Email:liguohui@tyut.edu.cn

With the explosive growth of communication traffic, increasing the modulation bandwidth of semiconductor lasers has attracted significant attention. However, after rapid progress has been achieved, further increasing the modulation bandwidth of semiconductor lasers is hampered by the slow charge-carrier dynamics. Here, we report a room temperature, single-mode perovskite nanolaser with sub-picosecond pulses, enabled by high Purcell enhancement. This enhancement is achieved via transferring an atomically smooth perovskite nanoplatelet onto the surface of an ultra-smooth SiO₂/Ag film. This nanolaser features a low mode volume (V) as low as $0.137 \mu\text{m}^3$, a high-quality factor (Q) up to 2180, and a low lasing threshold of $36.65 \mu\text{J}/\text{cm}^2$. The Q value of our laser is one order of magnitude higher than that of state-of-the-art nanolasers. The smoothness of both the nanoplatelet and the SiO₂/Ag film in our laser is critical to achieving a high Purcell enhancement. Polarization analysis reveals that the laser emission consists of a TM-polarized surface plasmon mode and a TE-polarized photonic mode. Furthermore, ultrafast charge-carrier dynamics indicate the surface plasmon decay time can be as short as 0.6 ± 0.4 ps due to the high Purcell enhancement. This work opens up the possibility of developing nanolasers with high bandwidths and ultra-small sizes.

Short Bio:



Dr. Guohui Li, associate Professor, College of Physics and Optoelectronics, Taiyuan University of Technology. Sanjin Talents. Research interests includes: Novel optoelectronic devices, Nonlinear Optics, Precision spectroscopy. Preside over several national and provincial research projects including: The key research program of Shanxi province; The key research program of Lvliang city; The commercialization cultivation program of Shanxi college research findings; National Natural Science Foundation of China. Published more than 60 peer reviewed paper including Advanced materials, Advanced functional materials, Laser Photonic Reviews, Advanced optical materials, Photonics research. Applied more than 20

invention patents. Given more than 20 oral talks on academic conferences including 5 invited talks.