ENHANCED PERFORMANCE OF MULTIWAVELENGTH NANOWIRE LASERS

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Introduction

Semiconductor III-V nanowires (NW) are promising building blocks for efficient and versatile nanophotonic lasers as they naturally integrate an active gain medium with a Fabry-Perot cavity and can natively be fabricated on silicon. In this study,[1] we demonstrate GaAs/GaNAs/GaAs core/shell/cap near-infrared NW lasers with substantially improved performance compared to previously reported GaNAs-based nanolasers. Moreover, we show how self-frequency conversion in the nanowires extends the wavelength range of coherent light to the cyan-green spectral range.

Results

In this study, we demonstrate GaNAs-based nanowires with a reduced average lasing threshold (6.9 μJ/cm2/pulse compared to 21.4 for previously reported GaNAs NW lasers), and a lasing yield of >70%. Moreover, lasing is found to be sustained up to 250 K, significantly higher than what was previously reported. The origin of the improved performance is explained by a reduction of the density of localized states.

Additionally, our study uncovered self-frequency conversion of the fundamental lasing light to the cyan-green emission range through second harmonic and sum frequency generation. The efficiency of this nonlinear optical process was found to vary between different lasing modes, attributed to differences in light extraction and electric field distribution.

Conclusions

GaNAs-based NW lasers with significantly improved performance are demonstrated. Self-frequency conversion is shown to extend the spectral range into the cyan range. Our findings pave the way for applications of GaNAs NWs in nanophotonics.

References

[1] M. Jansson et al. ACS Nano, 18, 1477 (2024)