Low-Threshold Lasing of Optically Pumped Micropillar Lasers with $Al_{0.2}Ga_{0.8}As/Al_{0.9}Ga_{0.1}As$ Distributed Bragg Reflectors

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Micropillar photonic devices, where an optical cavity is embedded in distributed Bragg mirrors (DBRs), are key building blocks to enable quantum technology and to study cavity quantum electrodynamics effects. Here, we report on low-threshold lasing of optically pumped micropillar lasers by replacing the commonly used $GaAs/Al_{0.9}Ga_{0.1}As$ DBRs with low-absorbing $Al_{0.2}Ga_{0.8}As/Al_{0.9}Ga_{0.1}As$ DBRs. Through pump-wavelength-dependent I/O measurements, we demonstrate that the incorporation of 20% Al content in the DBRs opens an optical pumping window from the absorption edge of $Al_{0.2}Ga_{0.8}As$ at 700 nm to the one of GaAs at 820 nm, wherein the excitation laser light can effectively pump the GaAs cavity while remaining transparent to the DBRs. By simply changing the laser wavelength from 671 to 708 nm in the low-absorbing scheme, we observed more than an order of magnitude lasing threshold reduction from (363.5 ± 18.5) μW to (12.8 ± 0.3) μW. [1] The improved power efficiency enables the upscaling of the micropillar lasers as optical neurons in photonic neuromorphic computation [2].

References

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