Data-Driven Design of Quasi-Periodic Plasmonic Lattice Structure Based on the Desired Optical Band Structure

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APPLIED PHYSICS
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RESEARCH OBJECTIVE

This research proposes to create quasi-periodic lattices by stacking two regular lattices with different periodicity to provide more choices of symmetry and thus more tunable lattice parameters with which to engineer the band structure. This opens opportunities for unique lasing behavior such as large angle emission or asymmetric emission profile, and has potential applications for non-linear optical physics and quantum optics.

Fabrication Process

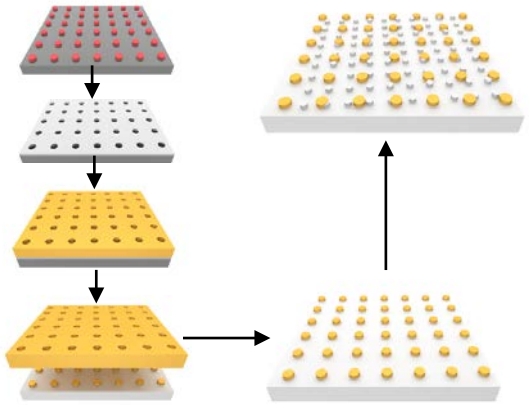
Soft lithography

Photoresist pattern on silicon wafer

Deposit Cr Mask
Etch silicon

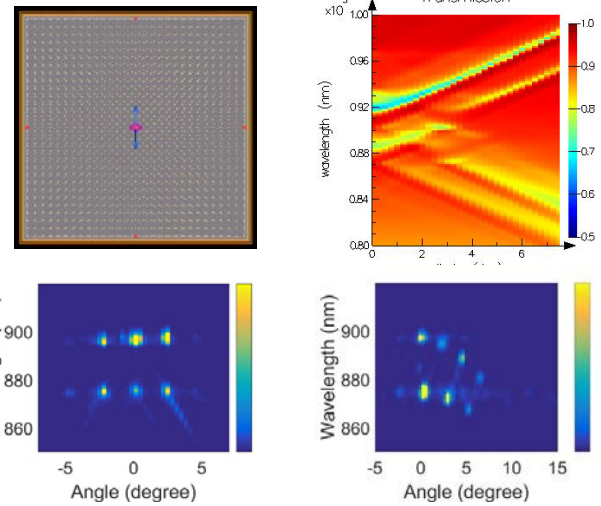
Deposit Au

Deposit metal through Au hole array mask



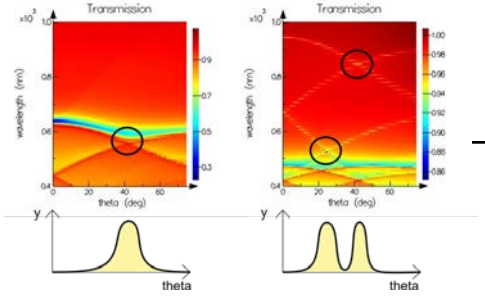
Courtesy to Weijia Wang

Lattice Structure – Band Structure – Lasing Property

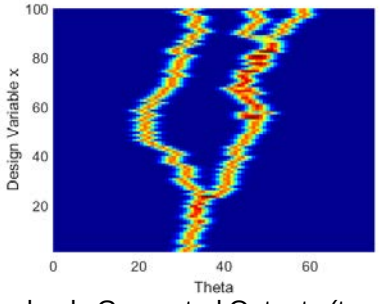


PREDICTIVE METAMODELING

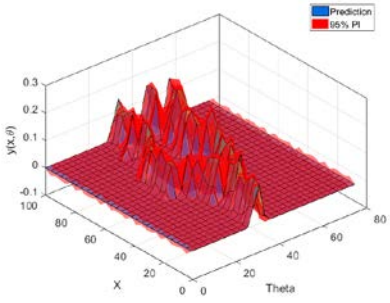
To circumvent the prohibitively expensive simulations and capture the varying positions and numbers of band-edge modes, a metamodeling approach with scalar inputs and functional outputs was developed. The functional outputs are multi-modal Gaussian functions whose peaks are centered at the emission angles that show lasing.



Functional Outputs



Randomly Generated Outputs (top view)



Response Surface of Trained Model

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