Multiresonant Plasmonic Meshes for Bio-interfaced Sensing and Actuation

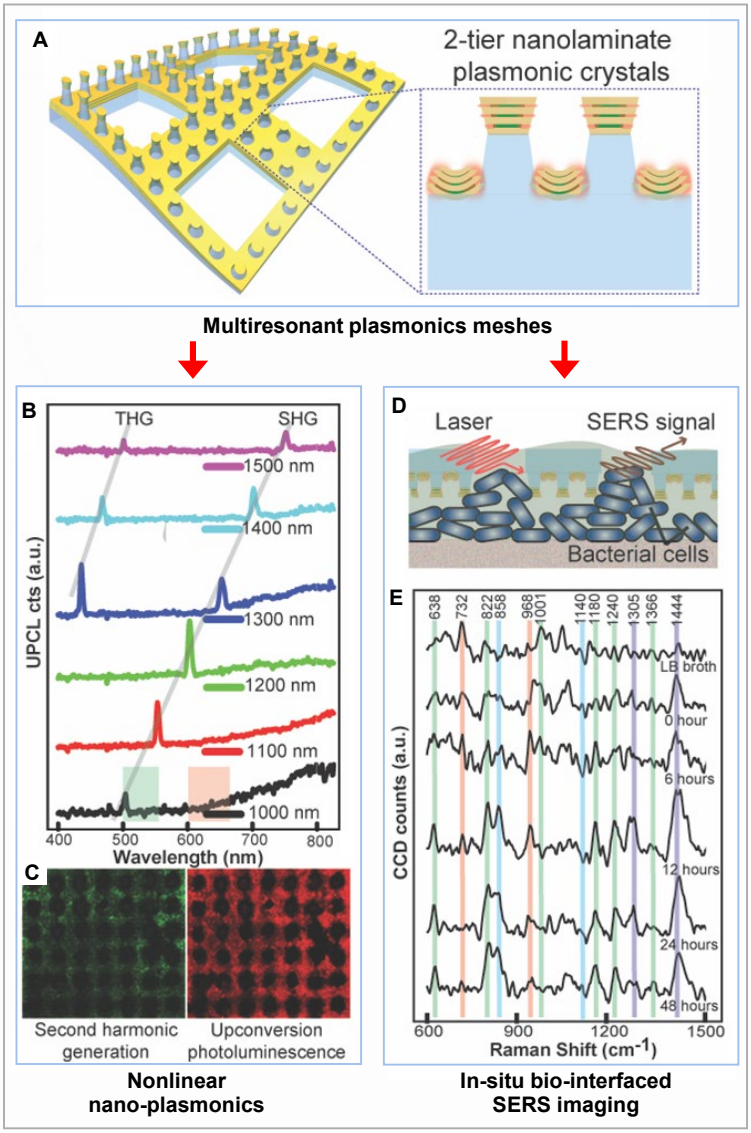
VTIP 22-042: "Flexible Microporous Multiresonant Plasmonics Meshes by Hierarchical Micro-nanoimprinting with Dissolvable Templates"

THE CHALLENGE

Mesh plasmonic devices have the potential to combine the biocompatibility of polymeric meshes with the capabilities of plasmonic nanostructures to enhance nanoscale light-matter interactions for bio-interfaced optical sensing and actuation. However, scalable integration of uniformly structured plasmonic hotspot arrays with polymeric meshes remains challenging due to the processing incompatibility of conventional nanofabrication methods with flexible microporous substrates.

OUR SOLUTION

This technology puts forth a strategy for the nanofabrication of wafer-scale multi-resonant plasmonic meshes (MPMs) via a cost-effective hierarchical micro-/nanoimprint lithography approach. MPMs can function as bio-interfaced broadband non-linear nanoplasmonic devices and surface-enhanced Raman spectroscopy (SERS) mesh sensors that enable in-situ spatiotemporal molecular profiling of biological systems. Such devices can open exciting avenues for bio-interfaced optical sensing and actuation applications, such as inflammation-free epidermal sensors, combined tissue-engineering and biosensing scaffolds for in vitro 3D cell culture models, and minimally invasive implantable probes for long-term disease diagnostics and therapeutics.



(A) Schematic illustration of the multiresonant plasmonic mesh. (B) Spectra of nonlinear scattered light under fs-laser excitation in the near-infrared region from 1000 nm to 1500 nm. (C) Multiphoton microscopy 2D images under fs-laser excitation at 1000 nm with the emission detected at 500-550 nm (green) and 601- 657 nm (red). (D) Schematic illustration of the experimental setup for in-situ spatiotemporal molecular profiling of bacterial biofilm formation and growth. (E) Average SERS spectra of Pseudomonas syringae biofilms measured between 0 and 48 hours (green bars = protein peaks, red bars = nucleic acid peaks, blue bars = carbohydrate peaks and purple bars = lipid peaks).

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