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The Role of Localized and Propagating Surface Plasmons in Periodically-Arrayed NAnopillars FRANCISCO BEZARES, JOSHUA CALDWELL, OREST GLEMBOCKI, RONALD RENDELL, MARIYA FEYGELSON, Naval Research Lab, MARAIZU UKAEGBU, Howard University, RICHARD KASICA, NIST, LORETTA SHIREY, NABIL BASSIM, Naval Research Lab, CHARLES HOSTEN, Howard University — Periodically-arrayed nanopillars have been shown to exhibit evenly distributed electromagnetic (EM) fields and some of the largest average surface-enhanced Raman Scattering (SERS) enhancements reported for large-area nanostructures, making them ideal for optical sensors. Although these characteristics are thought to be the result of the combined contributions from localized (LSP) and propagating (PSP) surface plasmons, the degree to which each of these modes impacts the SERS enhancement efficiency of such nanostructures is unclear. To better understand the roles that LSPs and PSPs play in the SERS process, we have measured the SERS enhancement from periodic arrays of Au-coated Si nanopillar arrays that either feature both types of modes and those with only isolated LSP modes. These results illustrate that although the optimal nanopillar diameter (e.g. SPR condition) is determined primarily by the LSP modes, cooperative interactions between LSP and PSP modes result in at least an order of magnitude increase in the average enhancement factor and a broadening in the diameter response (e.g. increased SPR linewidth).

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