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Block copolymer based design of highly sensitive substrates for detecting single molecules by surface enhanced Raman scattering ATIKUR RAHMAN, CHARLES BLACK, Brookhaven National Lab — Surface enhanced Raman spectroscopy (SERS) relies on substrates with nanometer-scale curvature in order to concentrate and amplify the incident electromagnetic field to increase the spectroscopic signature of Raman scattering. The localization and amplification of incident light is maximum between two plasmonic nanostructures called as "hot spot". Here, we report a new, scalable method for fabricating high-performance SERS substrates based on self-assembly of nanostructured block copolymer thin films. Due to the high spatial density and extremely high field strengths of substrate hot spots, these substrate are capable of enhancing Raman scattering signals from target molecules by more than 10 billion times. We will describe the process of fabricating these remarkable diagnostic tools, which are ˜cm^2 area substrates composed of an extremely high density (˜10^{11} /cm^2) of hexagonally-arranged Au or Ag nanoparticles positioned atop ˜70nm tall silicon nanopillars. Key to the substrate performance is the sub-5 nm separation between particles, which we control with nm level precision. By systematically varying the gap between nanoparticles, we demonstrate that both the high hotspot density and sub 5nm hot spot gap are necessary to achieve the highest degree of enhancement of the Raman signal. The enormous enhancements provided by these substrates make possible the detection of single molecules.

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