Gold Nanoparticles Sliding on Recyclable Nanohoodoos-Engineered for Surface-Enhanced Raman Spectroscopy - DTU Orbit (13/04/2019)

Robust, macroscopically uniform, and highly sensitive substrates for surface-enhanced Raman spectroscopy (SERS) are fabricated using wafer-scale block copolymer lithography. The substrate consists of gold nanoparticles that can slide and aggregate on dense and recyclable alumina/silicon nanohoodoos. Hot-spot engineering is conducted to maximize the SERS performance of the substrate. The substrate demonstrates remarkably large surface-averaged SERS enhancements, greater than $10^7$ ($>10^8$ in hot spots), with unrivalled macroscopic signal uniformity as characterized by a coefficient of variation of only 8% across 4 cm. After SERS analyses, the nanohoodoos can be recycled by complete removal of gold via a one-step, simple, and robust wet etching process without compromising performance. After eight times of recycling, the substrate still exhibits identical SERS performance in comparison to a new substrate. The macroscopic uniformity combined with recyclability at conserved high performance is expected to contribute significantly on the overall competitiveness of the substrates. These findings show that the gold nanoparticles sliding on recyclable nanohoodoo substrate is a very strong candidate for obtaining cost-effective, high-quality, and reliable SERS spectra, facilitating a wide and simple use of SERS for both laboratorial and commercial applications.

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