

Block Copolymer Micelle Based SERS Substrate with High Sensitivity and Excellent Reproducibility

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We introduce a simple but robust method to fabricate an ultrahigh density array of silver nanocluster for surface enhanced Raman spectroscopy (SERS) substrate with high sensitivity and excellent reproducibility at a very large area (wafer scale) based on polystyrene-block-poly(4-vinyl pyridine) copolymer (PS-*b*-P4VP) micelles. After silver nitrates were incorporated into the micelle cores (P4VP) followed by the reduction to silver nanoclusters, we systematically controlled the gap distance between two neighboring silver nanoclusters ranging from 8 to 61 nm, while the diameter of each silver nanocluster was kept nearly constant (~ 25 nm). To make silver nanocluster array with a gap distance of 8 nm, the use of the crew-cut type micelles is required. Fabricated SERS substrate with a gap distance of 8 nm showed very high signal intensity with a SERS enhancement factor as high as 10^8 , which is enough to detect a single molecule, and excellent reproducibility (less than $\pm 5\%$) of the signal intensity. This is because of uniform size and gap distance of silver nanoclusters in a large area.