

Nanopatterning and tuning of optical taper antenna apex for tip-enhanced Raman scattering performance

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Abstract

This paper focuses on finding optimal electrochemical conditions from linear sweep voltammetry analysis for preparing highly reproducible tip-enhanced Raman scattering (TERS) conical gold tips with dc-pulsed voltage etching. Special attention is given to the reproducibility of tip apex shapes with different etchant mixtures. We show that the fractional Brownian motion model enables a mathematical description of the decaying current kinetics during the whole etching process up to the cutoff event. Further progress in preparation of highly reproducible smooth and sharp tip apexes is related to the effect of an additive, such as isopropanol, to aqueous acids. A finite-difference time-domain method based near-field analysis provides evidence that TERS performance depends critically on tip orientation relative to a highly focused laser beam. A TERS based criterion for recognizing gold tips able to couple/decouple optical near- and far-fields is proposed. © 2013 AIP Publishing LLC.

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