Evaporated gold island films subjected to electromagnetic radiation show a localized surface plasmon (SP) resonance exhibited as enhanced light scattering, the appearance of a SP absorption band, and enhancement of local electromagnetic fields. These unique properties have been applied to chemical and biological sensing using transmission localized surface plasmon resonance (T-LSPR) spectroscopy and surface-enhanced Raman spectroscopy (SERS). Development of these and other applications requires optimization of the morphology and optical properties of the island films.

Application of T-LSPR spectroscopy to gas sensing was demonstrated using the structural sensitivity of polymer films to different gases. T-LSPR transducers were fabricated by spin-coating of a polymer film onto Au island films (5 nm nominal thickness, evaporated on silanized glass and annealed). The optical response of the transducers to controlled amounts of analyte vapors was distinctly different between vapors of good compared to poor solvents, suggesting possible use in gas recognition.

Gold island films with various morphologies were studied as substrates for SERS, using Rhodamine 6G (R6G) as a model analyte. Substantial enhancement of the SERS signal was achieved when using the hierarchical film roughness obtained by a two-step evaporation procedure.

**Abstract**

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**Surface-Enhanced Raman Spectroscopy**

Substrate Characterization & Modeling

Cross-sectional TEM (left) and HRSEM (right) images

**Gas Sensing**

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**Summary**

- The optical response of polymer-coated T-LSPR transducers is sensitive to vapor analytes. Vapors of good solvents induce polymer swelling and thickness increase, manifested as a fast and fully reversible optical response to the presence of the analyte. No response is seen to poor solvent vapors. Polymer-coated Au island systems are therefore promising transducers for gas sensing in an array configuration (fingerprinting).

- The Raman spectrum of Rhodamine 6G adsorbed on a two-layer hierarchical Au island film was substantially enhanced relative to that obtained with a regular Au island film. Such substrates are therefore promising for surface-enhanced Raman spectroscopy (SERS) and can be optimized by controlling various morphological and interfacial parameters of the hierarchical system.