Laser Interference Lithography and Fabricated Nano-patterned Templates for Surface Enhanced Raman Scattering & Surface Enhanced Fluorescence

P. Mandal, Jhuma Dutta, Gangadhar Behera, A. Nandi, Prince Gupta and S. Anantha Ramakrishna

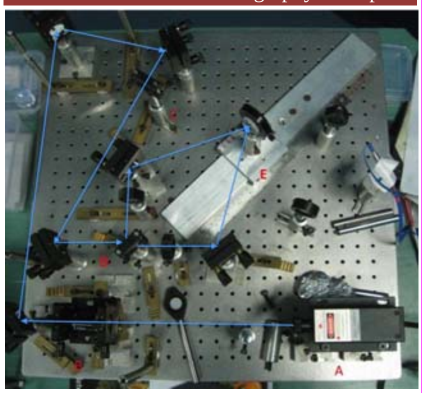
Department of Physics, Indian Institute Technology Kanpur, Kanpur – 208016, India

Introduction

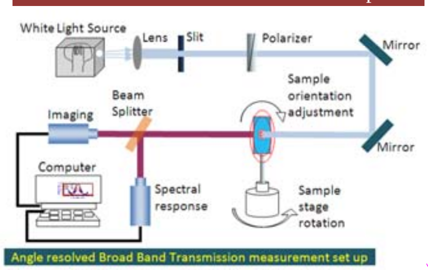
- Laser Interference Lithography is a cost effective technique to generate periodic structures in a very short duration. As no vacuum components are involved the handling of the systems is very easy. The methodology can be adapted to generate variety of dielectric as well as metal nanostructures in the sub-micron wavelength regime which actually depends upon the wavelength of the working laser (theoretically $\lambda/2$). The growth of plasmonically active templates for SERS is described sequentially below.
- Plasmonically active patterned templates, the source of hot-spots which are the reservoirs of concentrated near fields around metal nanostructures are extensively used for SERS and SEF. The templates are potential candidates for other optical studies such as non-linear optics, wave guiding, collimation and focusing of light, THz generation etc (but not limited to).
- Apart from the subjects mentioned above there have been many applications found in optoelectronics, biology and biomedicine, bio-sensors.

Sample Fabrication

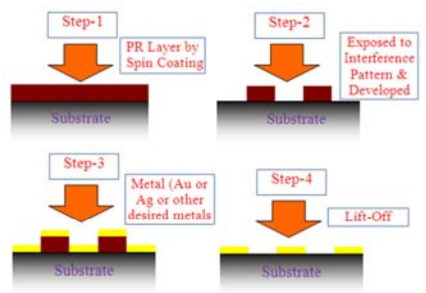
Laser Interference Lithography Set Up



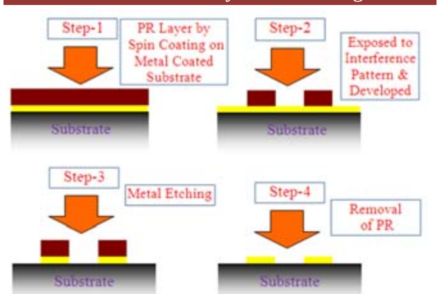
Transmission Measurements Set Up



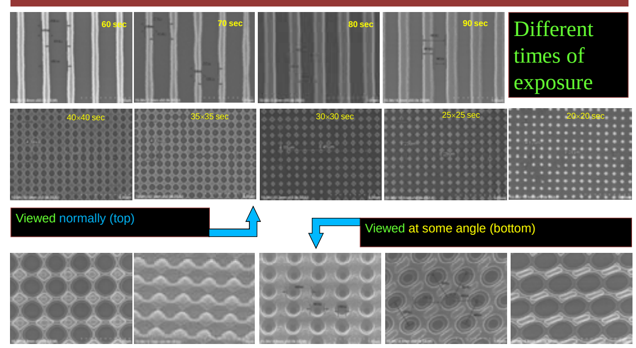
Photoresist Patterning, Metal Coating & lift-off



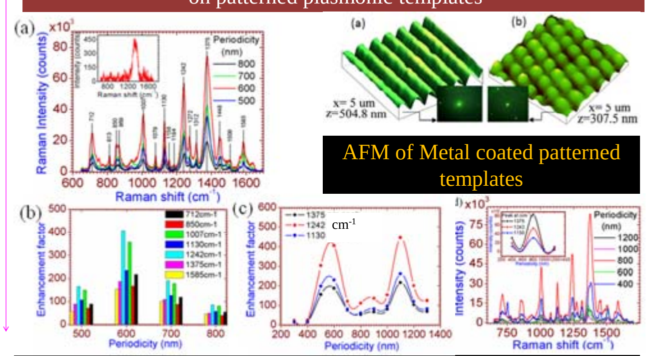
Nanostructures by Metal etching



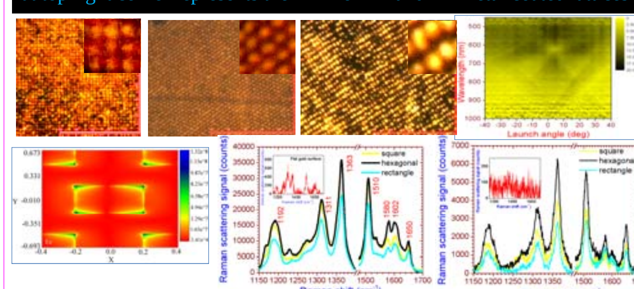
SEM images of PR pattern obtained by LIL



SERS investigation of 'R6G in PMMA' probe molecules on patterned plasmonic templates



SERS corresponding to 1D lattice (a-c) and 2D lattice (d). The figure (a-b) at top right corner represents the AFM of 1D and 2D metal coated lattices



(Top row, from left): Dark field images of 800 nm periodic square, hexagonal and rectangular lattices; typical SPP dispersion for 600 nm periodic square lattice. (Bottom row, from left): simulated Ez field for hexagonal lattice of 800 nm period, SERS excited with 785 nm, and 633 nm lasers.

Conclusions

- LIL is a cheaper way of fabricating plasmonic templates for SERS, SEF and other fundamental as well as technological applications. Variety of nanostructures can be prepared easily in a short time span.
- The templates are seen to offer reproducible results.
- SERS and SEF imaging and correlation with near field effect on the signal enhancement is under progress
- Directional and guiding effect of SPP for the random lasing in a gain medium is also under investigation.

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The authors acknowledge funding by the Asian Office of Aerospace R&D (AFOSR) via grant no. AOARD–10–4042. The assistance of Dr. S. Mukhopadhyay and Neha Jain at the IISER Mohali in obtaining the SERS data is also acknowledged.

Reference

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