**Unconventional Nanopatterning Techniques for Gold Nanostructures**

Chris Decker
Department of Mechanical Engineering,
Temple University,
Philadelphia, PA 19122

Aarthi Sundar
Department of Mechanical Engineering,
Temple University,
Philadelphia, PA 19122

Robert Hughes
Department of Mechanical Engineering,
Temple University,
Philadelphia, PA 19122

Svetlana Neretina
Department of Mechanical Engineering,
Temple University,
Philadelphia, PA 19122

## Unconventional Nanopatterning Techniques for Gold Nanostructures

*Chris Decker, Aarthi Sundar, Robert Hughes and Svetlana Neretina*

Department of Mechanical Engineering, Temple University, Philadelphia, PA 19122

The fabrication of periodic arrays of noble metal nanostructures immobilized on a substrate surface are of technological relevance to numerous applications including photovoltaics, seeded nanowire synthesis, waveguides, catalysis, chemical and biological detection, enhancement agents for light emitting diodes and the fabrication of metamaterials. Presently, such arrays are obtained using lithographic fabrication routes which are technically demanding and cost-prohibitive. Recently, numerous unconventional nanopatterning techniques have emerged which are cost-effective, but these techniques have been predominantly directed toward polymer materials where low processing temperatures are the norm. The development of similar routes for metals, where processing temperatures are considerably higher, has proved more challenging. The most straightforward method for obtaining substrate-based gold nanostructures is through the room temperature deposition of a continuous ultrathin gold film followed by its subsequent agglomeration at elevated temperatures. The main drawbacks of this thermal dewetting procedure are the substantial nanoparticle size distributions realized and the lack of control over nanostructure placement. Unconventional nanopatterning techniques directed toward polymer films have also demonstrated the utility of manipulating the dewetting phenomenon from the free surface of the film. In an analogous manner, three methodologies have been developed to test the viability of first depositing a thin gold film and then creating weak points in the film using mechanical means in an effort to activate the dewetting phenomenon such that film agglomeration occurs at predefined locations. The first approach utilizes a nano-indenter with a GS0-10 Load Cell and a 5 μm radius carbide tip, the second utilizes a micron-scale rigiflex mold applied to the surface using a Tinius Olsen 10000 electromechanical compression testing instrument, and the third uses an embossing technique to create a template for activating the dewetting through capillary forces. The gold patterns formed will be presented and the viability of advancing these methodologies towards a cost-effective bench-top process for forming arrays of metal nanoparticles will be discussed.