**Electrochemical Stamping for Metal Nanomanufacturing**

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### Goals
- Understand the fundamental science involved in the process.
- Develop relevant complementary processes to implement the process at an industrial scale.
- Develop novel bio and chemical sensing elements to for nanoscale sensing.

### Mapping to Center’s Objectives

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<th>Micro-Nano Fluidic Toolkit</th>
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### Fundamental Questions/Challenges

#### Dynamic kinetics/transport behaviors.

- Experimental verification of developed model.
- Effect of stamp material property changes on S4 patterning.
- Characterization of different sensor designs and their optimization.

#### Theoretical limit in resolution.

- Coupled experimental and theoretical study on simple sensing elements through SERS and MEF.

### Interaction with Other Projects

- **Micro-Nanofluidic Toolkit**
  - J. Georgiadis, M. Shannon, N. Aluru: Computational Tools and Models for Electrokinetic Nanoflows
  - P. Ferreira, N. Fang: Solid-State-Supersonic Stamping (S4)

- **Manufacturing Systems**
  - M. Yu, P. Ferreira: Integrated & Versatile Testing platform
  - S4-MacEtch for Thermoelectrics (Collaboration with Li and Sinha group)

### Broader Impact
- Design tool for plasmonic sensing for applications in optics, bioengineering, and electronics.
- Represents a viable alternative to mass production of existing metal based structures ranging from macro to nanoscale.

### Research Results

- **Theoretical model**
- **Experimental results**
- **Matching of prediction**

#### Sensor characterization

- Raman scattering and fluorescence enhancement

#### Sensor characterization

- Effect on S4 patterning

### Future Efforts

- Experimental verification of numerical model on S4 process.
- Full-scale parametric study of mechanical properties of S4 stamps on S4 process performance.
- Construction of database for plasmonic sensing element geometry and characterization for optimization.