Plasmonic Surface Made with Nanoimprint Lithography with Block Copolymer Mold

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[a]Sandia National Laboratories
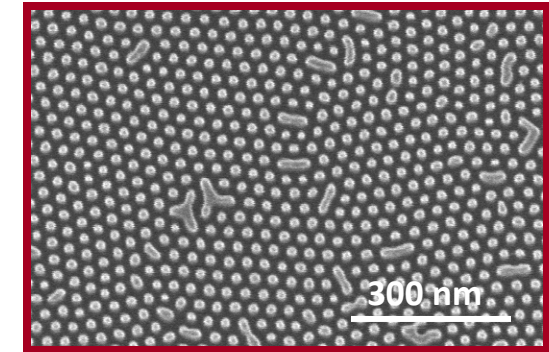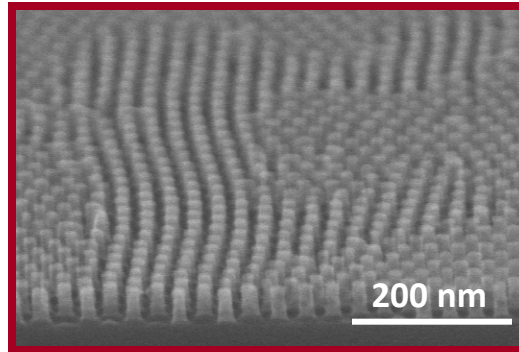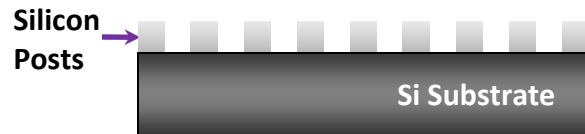
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Goals

- Use self-assembled block copolymers (BCPs) to create a nanoimprint lithography (NIL) mold. – Completed ✅

- Create plasmonic surface with BCP-patterned NIL mold. – Completed ✅

- Create a NIL mold with long range order of the BCPs via prepatterning of the brush with interference lithography (IL). – Ongoing ⚙️

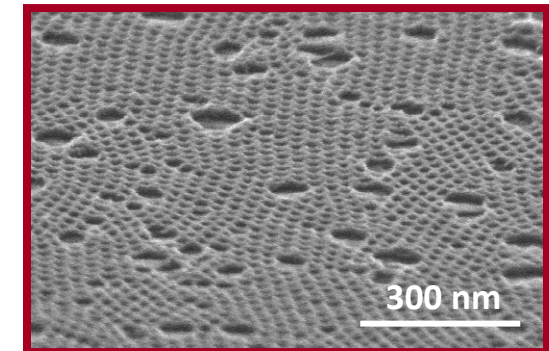- Reproduce features as a demonstration of combined IL/BCP/NIL nanofabrication. – Ongoing ⚙️

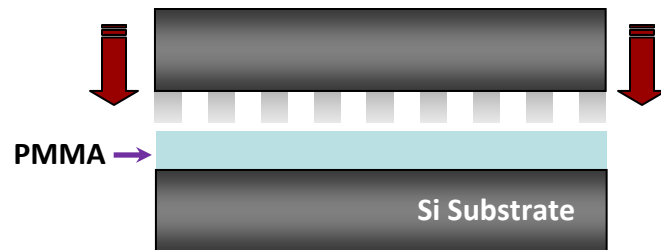THE UNIVERSITY of WISCONSIN MADISON

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Fabrication of Patterned Nanodots
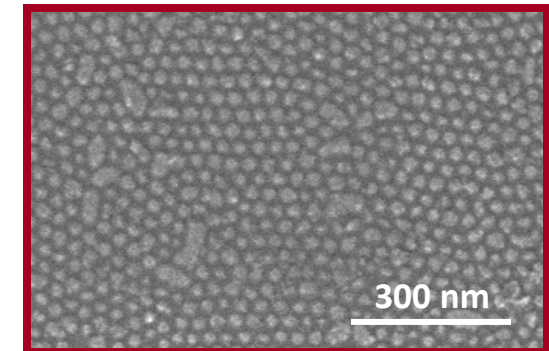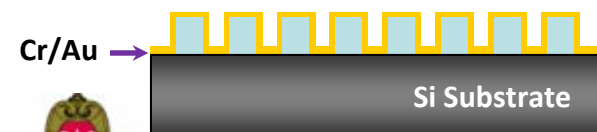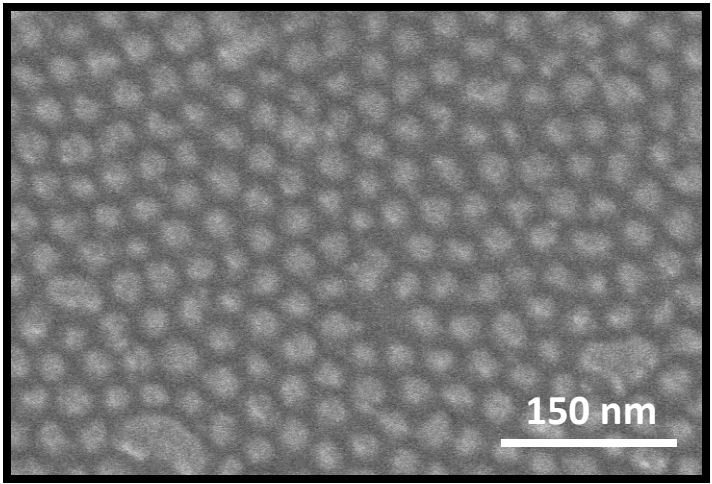
1 *Silicon Posts as Template for NIL*

Silicon Posts →

Si Substrate

2 *Imprint of Template into PMMA*

PMMA →

Si Substrate

Si Substrate

3 *Metal Deposition and Liftoff*

Cr/Au →

Si Substrate

Si Substrate

More SEMs of Nanodots
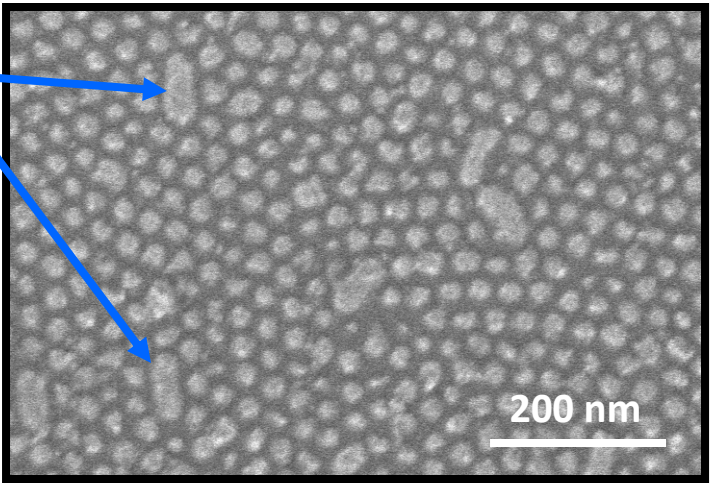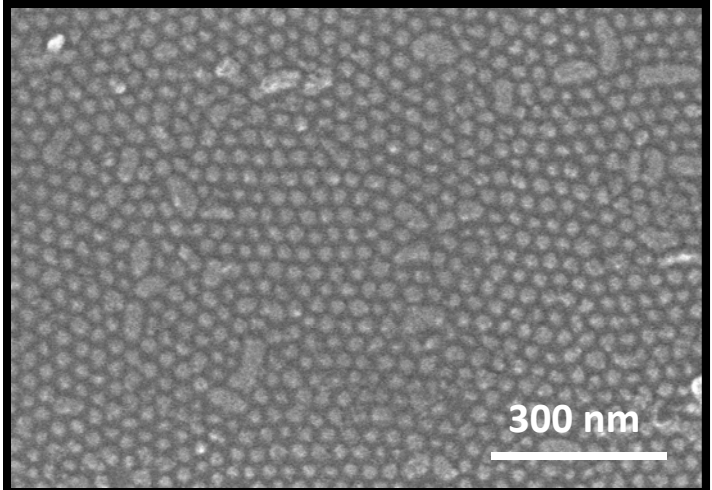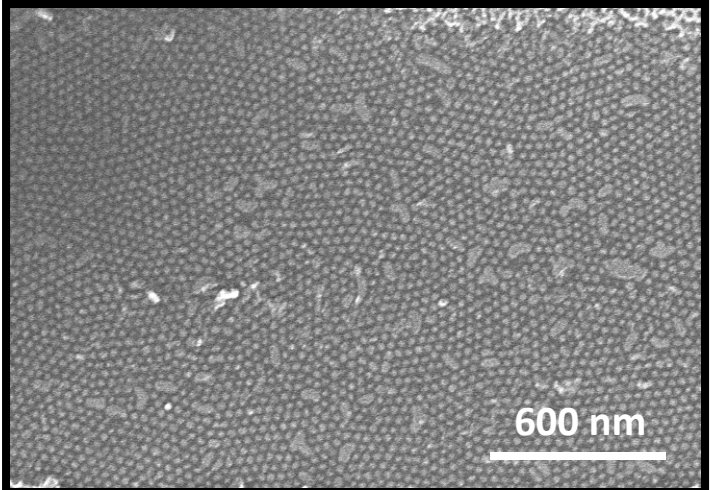
Defects transferred from imperfections in orginal template and imprint process

600 nm

300 nm

200 nm

150 nm
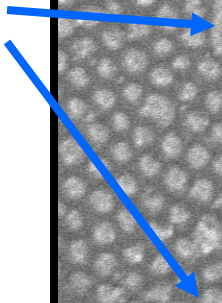
Raman Scattering Plots

Rhodamine 6G

- **Commonly used as a laser dye**

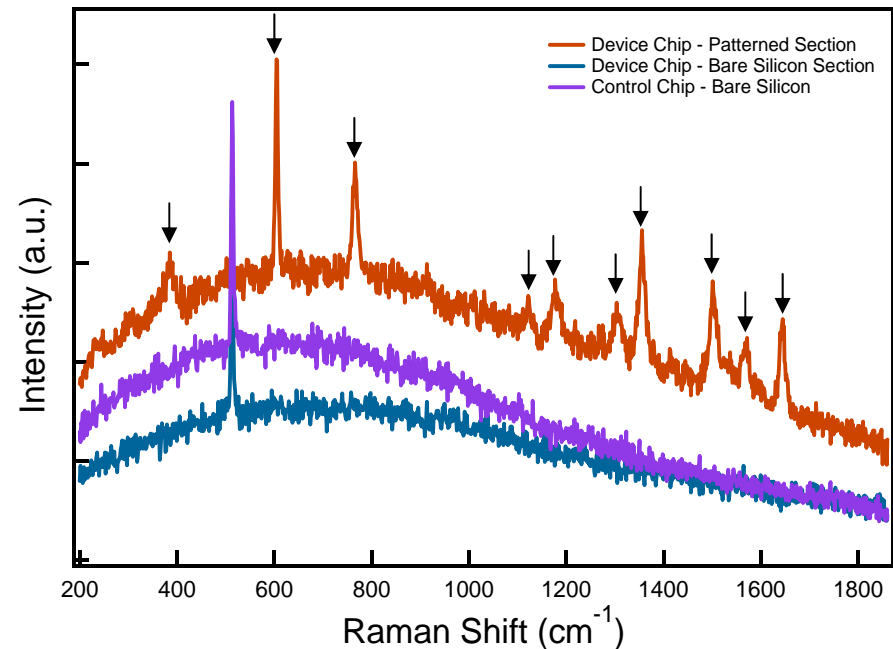- **Also common in SERS experiments due to recognizable Raman signature**
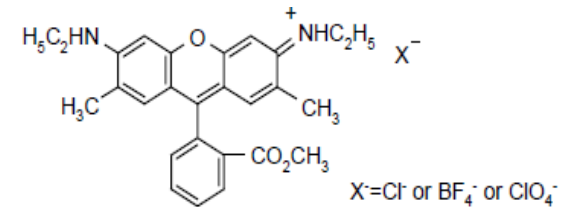
Raman Testing Procedure

- **R6G powder dissolved in methanol**

- **1 drop deposited on substrate and allowed to evaporate**

- **Sample interrogated with 532 nm line of Nd:YAG laser at around 1 mW power**

- **Raman Spectra Collected**

Results

- **R6G peaks (arrows on plot) apparent on samples with patterned nanodots, indicating plasmonic enhancement**

- **No R6G peaks apparent on bare silicon**

Arrows denote R6G Raman scattering peaks

Legend:
- Device Chip - Patterned Section
- Device Chip - Bare Silicon Section
- Control Chip - Bare Silicon

Intensity (a.u.) vs Raman Shift (cm^{-1})

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Summary and Conclusion

- Pattern transfer of metal nanodots was completed with use of BCP-patterned NIL template.

- Raman spectroscopy was used to verify field enhancement with patterned nanodots on Si surface.

- Results were submitted to EIPBN 2010.

Future Work

- We still need to increase yield through process modification.

- We will explore plasmonic behavior on surfaces other than bare Si.

- We would like to perform NIL with a combined IL-BCP-NIL template.