Let's Do the Twist:

From Epitaxial Block Copolymer anopatterns to Graphene Bilayers

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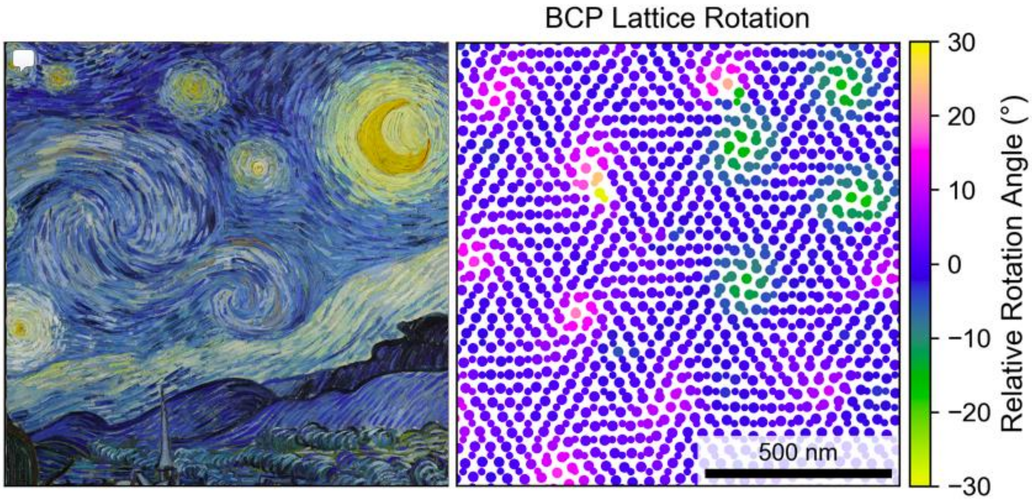
Résumé/Abstract: Nanopatterned surfaces are of central importance to a variety of areas and applications, such as computer chip architectures, tissue interfacing, biosensors, light management and plasmonics, among others. Typically, the various approaches to nanopatterning of surfaces, including silicon, are broken into two major classes: top-down methods such as photolithography, e-beam lithography and scanning force microscopy variants, and bottom-up synthetic techniques, including self-assembly. Since lithography is the single most expensive step in computer chip manufacturing, the use of self-assembled block copolymers (BCPs) templates on surfaces is being seriously considered by the semiconductor industry to pattern sub-20 nm features on a semiconductor surface; the Industry Technology Roadmap for Semiconductors (ITRS) terms this approach 'directed self-assembly', or DSA.[1] Here, we will describe the remarkable versatility of using BCPs, polymers that contain sufficient chemical information to form highly ordered templates over large areas. Recently, experimental observation of static distortion waves (SDWs), local chiral twisting of lattices, has become a topic of extreme interest in the area of graphene-based patterns and structures[2] - perfect timing, since we have discovered unable SDWs in block copolymer-based self-assembled structures that are at least an order of magnitude larger in scale, and could thus serve as an easily studied model for these graphene motifs.[3]



Scheme 1. Left: van Gogh's Starry Night. Right: Standing Distortion Waves produced via self-assembly of block copolymers on silicon.

References

1. The International Technology Roadmap for Semiconductors: www.itrs2.net

2. Cao, Y. *et al* Correlated insulator behavior at half-filling in magic-angle graphene superlattices, *Nature* **2018**, *556*, 80-84.

3. Jin, C. *et al* Preferential Alignment of Incommensurate Block Copolymer Dot Arrays Forming Moiré Superstructures. *ACS Nano* **2017**, *11*, 3237-3246.

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APPOINTMENTS

Postdoctoral Fellow	Scripps Research Institute, La Jolla, CA,	1995-1997
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RESEARCH INTERESTS
(1) Materials for renewable energy applications
(2) Self-assembly on surfaces
(3) Surface chemistry of nanomaterials

SELECTED PUBLICATIONS

1. Jin, C.; Olsen, B. C.; Luber, E. J.; Buriak, J. M. Preferential Alignment of Incommensurate Block Copolymer Dot Arrays Forming Moiré Superstructures. *ACS Nano* **2017**, *11*, 3237-3246.
2. Cao, B.; Adutwum, L. A.; Oliynyk, A. O.; Luber, E. J.; Olsen, B. C.; Mar, A.; Buriak, J. M. How to Optimize Materials and Devices *via* Design of Experiments and Machine Learning: Demonstration Using Organic Photovoltaics. *ACS Nano* **2018,** *12*, 7434-7444.
3. Xie, H.; Tan, X.; Luber, E. J.; Olsen, B. C.; Kalisvaart, W.P.; Jungjohann, K. L.; Mitlin, D.; Buriak, J. M. β-SnSb for Sodium Ion Battery Anodes: Phase Transformations Responsible for Enhanced Cycling Stability Revealed by In-situ TEM. *ACS Energy Lett.* **2018**, *3*, 1670-1676.
4. Aghajamali, M.; Xie, H.; Javadi, M.; Kalisvaart, W. P.; Buriak, J. M.; Veinot, J. Size and Surface Effects of Silicon Nanocrystals in Graphene Aerogel Composite Anodes for Lithium-Ion Batteries. *Chem. Mater.* **2018,** *30*, 7782-7792.
5. Hu, M.; Hauger, T. C.; Olsen, B. C.; Luber, E. J.; Buriak, J. M. UV-Initiated Si-S, Si-Se and Si-Te Bond Formation on Si(111): Coverage, Mechanism, and Electronics. *J. Phys. Chem.* , **2018,** *122*, 13803–13814.