Designer Gradients Speed Surface Science Experiments

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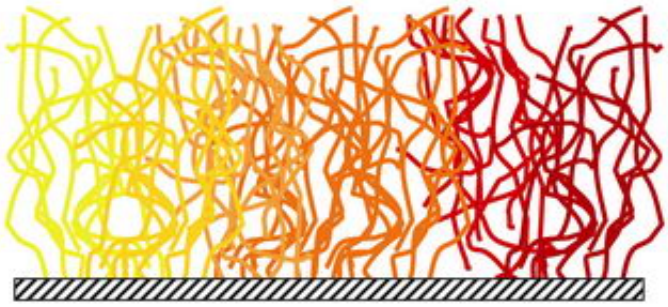

Researchers from the National Institute of Standards and Technology have demonstrated an elegantly simple technique for synthesizing a wide variety of complex surfaces that vary in a controlled fashion across a test strip. The new technique is so flexible that it can be applied to surface science experiments ranging from developing better paints to exploring the bonding of proteins to cell membranes.

So-called “gradient composition surfaces”—their chemical composition changes gradually across the surface—have been shown to be powerful research tools for rapid, high-throughput testing of complicated surface properties, but they can be tricky to build. The new NIST technique described in a recent paper in *Advanced Materials* coats a silicon wafer with a brush-like copolymer surface, varying the relative concentration of two components, or monomers, of the polymer along the length of the

substrate. The dense polymer brush provides a controlled interaction surface at the top while effectively masking the underlying substrate.

The heart of the NIST technique is a combined microfluidic mixer and reaction chamber. The two components are injected into the mixer with gradually changing flow rates and mix thoroughly before filling a thin reaction chamber holding the silicon wafer substrate. Once the solution leaves the mixing region, the narrow dimensions of the reaction chamber inhibit further mixing, so the varying composition ratios through the chamber remain stable while the solution polymerizes on the substrate.

Because it keeps the fluid mixture concentrations stable for long periods, the new technique is unique in its ability to accommodate a wide variety of materials, potentially producing test surfaces for studying surface phenomena ranging from nanoscale interactions of biomolecules—critical for improving the performance of tissue-engineered medical products or for identifying the fundamental mechanisms key to cell/surface adhesion—to the performance of new products like paints or adhesives. The specific polymer used in these proof-of-concept experiments, for example, is typical of a temperature- or acidity-sensitive polymer that might be used in a drug delivery system.

Citation: C. Xu, S.E. Barnes, T. Wu, D.A. Fischer, D.M. DeLongchamp, J.D. Batteas, and K.L. Beers. Solution and surface composition gradients via microfluidics confinement: fabrication of a statistical-copolymer-brush composition gradient. *Adv. Mater*. 2006, 18, 1427-1430.

Source: NIST

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