

A nanovolcano array

Tribocharging—the buildup of electric charge on surfaces after they are rubbed together—was first recorded by Thales of Miletus in the sixth century BCE. It's what most of us associate with static electricity. Beyond merely a subject of introductory physics labs, it shows promise in such applications as energy harvesting, mass spectrometry, and electronics. The phenomenon is mostly studied on flat surfaces, which create continuously spread charges. Researchers at Iowa State University and Ames Laboratory have now studied it on nanotextured surfaces and demonstrated that the distribution of tribocharges can be localized and even patterned at nanometer dimensions. The electric fields from the nanopatterned tribocharges offer a new means for creating nanoscale structures, such as the “nanovolcanoes” in this atomic-force micrograph.

The array's conical nanovolcanoes have a base diameter of 500 nm,

with 2.6 μm separating the yellow crests. The researchers fabricated the array in a two-step process. They first created electrically charged nanocups by replicating a polycarbonate nanocone array with the elastomer poly(dimethylsiloxane), or PDMS. When they peeled off the cured PDMS layer, the friction left a ring of negative charges just below each cup's rim. The PDMS nanocups then served as a mold for a second polymer in a process known as electrohydrodynamic lithography: The electric field from the tribocharge rings attracted the second polymer and shaped it into nanocones with 10 nm craters at the top—the nanovolcanoes. By modeling the crater formation, the researchers could determine not only the distribution pattern of tribocharges but also the frictional stresses that generated them. (Q. Li, A. Peer, I. H. Cho, R. Biswas, J. Kim, *Nat. Commun.* 9, 974, 2018; image submitted by Rana Biswas.)

—RJF

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