New science on cracking leads to self-healing materials

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Cracks in the desert floor appear random to the untrained eye, even beautifully so, but the mathematics governing patterns of dried clay turn out to be predictable—and useful in designing advanced materials.

In a pair of new studies from Princeton University, researchers found that in a large class of common materials, including clay and human skin, individual grains of the material shrink as they dry. The amount and speed of shrinkability varies with the material's physical properties. By harnessing this previously unknown trait, the researchers are able to predict, and even reverse, cracking over time.

"The application of materials that spontaneously heal themselves, by leveraging shrinkability, is something I'm very excited about," said Sujit Datta, assistant professor of chemical and biological engineering at Princeton University and lead author on the studies.

In the first paper (*Soft Matter*, DOI: 10.1039/C9SM00731H), by balancing conditions just so, the researchers fine-tuned a shrinkable granular material so that it alternately cracked apart in precise clusters, didn't crack at all, or started to crack but closed again.

The second paper, due out October 10 in *Physical Review Letters*, lays out the general physics governing shrinkability—that is, how each grain changes individually as it interacts with the aggregate, and how this trait impacts the sizes of clusters left after a granular material cracks. Nearly a century of work in this field had assumed all grains retain their size, failing to describe the shrinking of individual grains in such materials. The revelation impacts everything from biomedical treatments to fuel cells to toxic-waste containment.

More information: H. Jeremy Cho et al. Crack formation and self-closing in shrinkable, granular packings, *Soft Matter* (2019). DOI: 10.1039/C9SM00731H

"Scaling law for cracking in shrinkable, granular packings", *Physical Review Letters*, journals.aps.org/prl/accepted/ … 732c7f142ea0698a4156

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