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Self-replicating cracks

A new fracture mechanism explains unusual crack patterns in thin coatings.
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septiembre 2014

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Self-replicating cracks
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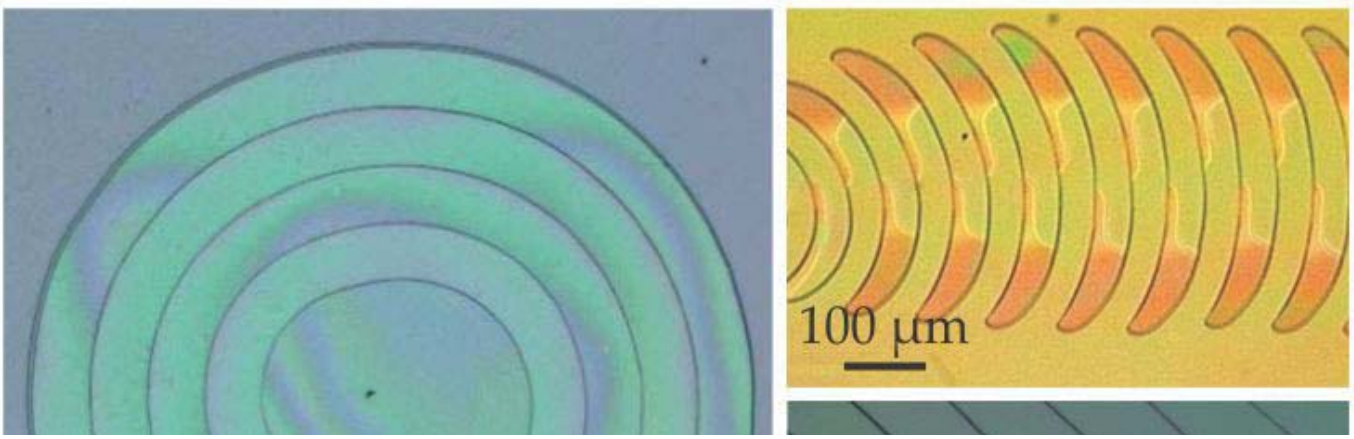
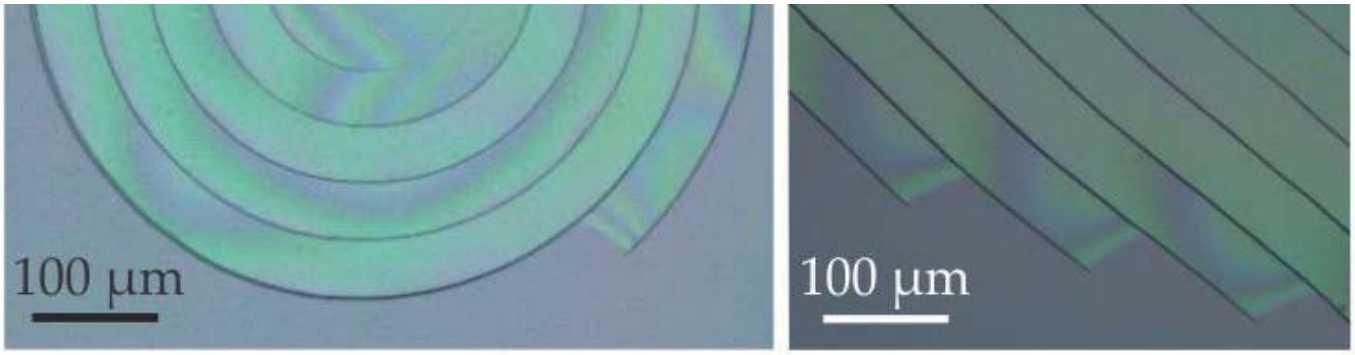
Surface coatings, found on everything from painted walls to computer chips, tend to form cracks that relieve residual stresses built into the film during deposition, drying, or mechanical loading. The cracks typically grow into a disordered pattern, such as the crackle glaze on pottery. But **Joel Marthelot** (now at MIT), **Benoît Roman**, and **José Bico** of ESPCI ParisTech and their colleagues from the Saint-Gobain Corp and the University of Santiago have explored a different class of crack patterns. Working with spin-on glass—a coating material commonly used for electronic components—on a silicon substrate, the researchers induced ordered crack patterns like the ones in the optical microscopy images below. While studying the unusual patterns, they discovered a new fracture mechanism in which delamination and fracture happen simultaneously and leave behind a peeled area between cracks where residual stresses have been released. That "collaborative" process leads to spontaneous self-replication of an initial template: New cracks run next to previous fracture paths, with the distance between cracks governed by the thickness of the film. What's more, nucleation conditions can trigger particular patterns—spirals radiate out from isolated defects, relatively long initial cracks cause crescent-shaped patterns, and paralle bands form near boundaries. The new fracture mechanism, the researchers suggest, could turn something that's usually considered a nuisance phenomenon into a novel design tool to tailor surface microstructures. (J. Marthelot et al., ***Phys. Rev. Lett.*** 113**, 085502, 2014**.)

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