Professor Derek Breid

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PhD research interest:
A stiff skin bonded to a soft underlayer will wrinkle when compressed laterally. Given the proper materials, those wrinkles may be on the micro- or nano- scale, and would provide an easy route to introduce microscale topography on a surface. For example, under equibiaxial compression, there are two distinct patterns that may emerge: at high stresses , the wrinkles form a zig-zag or "herringbone" pattern, while at low stresses, a hexagonally-packed array of dimples emerges. My research involves the careful control of stress application by swelling the soft underlayer with solvent vapor, and observing the resulting morphological evolution. Geometric controls, such as patterning or surface curvature are also used to modify hte surface stresses. Complementing my experimental results are Finite Element models that can be used to calculate stress profiles across the swelling surface.

More research interests (from http://www.derekbreid.com/)**:**
This is the personal page of Derek Breid, Ph. D. I am currently working as a postdoctoral associate in the lab of Dr. Sachin Velankar in the Chemical and Petroleum Engineering department at the University of Pittsburgh. Prior to this position, I earned my Ph. D. in Polymer Science and Engineering under the supervision of Dr. Al Crosby at the University of Massachusetts-Amherst. My research focuses on harnessing the mechanical behavior of soft materials in the design of responsive surfaces with novel properties. Below you will find summaries of past and ongoing research projects, and my CV may be accessed using the menu above. Wrinkling processes have garnered much interest as methods for spontaneous generation of microscale topography for a variety of material applications. These methods yield a rich spectrum of periodic

morphologies, but the complex interplay between kinetic and dynamic processes which bring these patterns about is not well-understood. We have quantitatively studied the effects of stress magnitude and directionality on the formation of wrinkle patterns at long timescales using swelling of a surface-oxidized elastomer via solvent vapor.

Selected Publications:

Derek Breid and Alfred J. Crosby, "Surface wrinkling behavior of finite circular plates", Soft Matter, Vol. 5, No. 2, pp 425-431, 2009

S. Cai, D. Breid, A. J. Crosby, Z. Suo and J. W. Hutchinson, Periodic patterns and energy states of buckled films on compliant substrates, Journal of the Mechanics and Physics of Solids, 59 (2011) 1094–1114

Derek Breid and Alfred J. Crosby, "Effect of stress state on wrinkle morphology", Soft Matter, 2011, Vol. 7, pp. 4490-4496

Derek Breid, "Controlling morphology in swelling-induced wrinkled surfaces", Ph.D dissertation, Polymer Science and Engineering, University of Massachusetts – Amherst, February 2012

Derek Breid and Alfred J. Crosby, "Curvature-controlled wrinkle morphologies", Soft Matter, Vol. 9, pp 3624-3630, 2013