Professor Shengqiang Cai

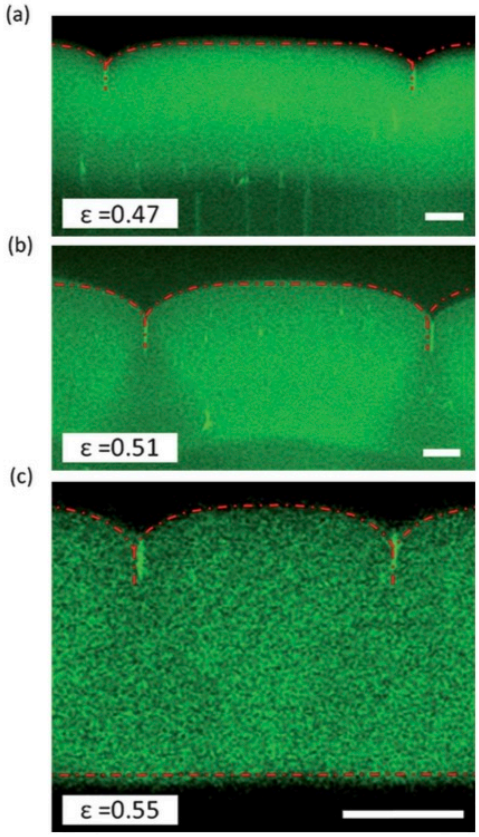

Fig. 4 Comparisons between calculated surface profiles (red dotted lines) and experimental cross-sections determined by confocal microscopy (green images), for elastomer surfaces in the creased state at three levels of strain. Initial film thicknesses H were (a) 93 μm, (b) 91 μm and (c) 23 μm (scale bars represent 20 μm). For the thinnest film in (c), it is also possible to observe the film/substrate interface.

From: S. Q. Cai, D. Y. Chen, Z. G. Suo, and R. C. Hayward, "Creasing instability of elastomer films," Soft Matter, vol. 8, pp. 1301-1304, 2012.

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Biography:
In response to a stimulus, soft materials, such as hydrogels and elastomers, can deform dramatically. This deformation provides most of their functions. Cai and his colleagues have formulated theories to better understand the interplay of mechanics and other fields, including chemistry, electric field and temperature, in soft materials. He has also studied several ways of using soft active materials to convert energy in different forms. Cai is currently investigating how to design and optimize structures made of soft materials to provide

diverse functions, including harvesting energy, regulating fluid and desalinating salt water. He is also looking into using the mechanical instability phenomena associated with large deformation in soft materials to guide electromagnetic waves and provide other functions.
Prof. Cai was a postdoctoral fellow at the Massachusetts Institute of Technology from 2011 to 2012.

Education:
2007 - 2011 PhD Mechanical Engineering, Harvard University
2004 - 2011 MS Solid Mechanics, University of Science & Technology of China
2000 - 2004 BS, Theoretical and Applied Mechanics, University of Science & Technology of China

Research Interests:
Solid Mechanics; Mechanics of soft materials; Mechanics of biological materials; Active materials and structures; Fracture and fatigue properties of polymer Instability; Multifield coupling phenomena

Professor Cai is head of the Cai Group at UCSD:
Soft materials can be easily found in biological systems and daily life. But, the research on the mechanics of soft materials is still in a nascent stage. Our research aims to understand some fundamental mechanics of various soft materials, such as large deformations and instabilities in elastomers, kinetics in polyelectrolytes, optical-mechanical coupling effects in liquid crystal elastomers and the growth of biological materials. We are also interested in exploring diverse engineering applications of soft materials.

Selected Publications:
X. Liang, S. Q. Cai, “New electromechanical instability modes in dielectric elastomer balloons,” International Journal of Solids and Structures, Vols. 132-133, pp 96-104, 2018
Y. Zheng, Al Crosby, S. Q. Cai, “Indentation of a stretched elastomer,” Journal of the Mechanics and Physics of Solids, pp. 145-159,2017.
Li, K. , Wu, W. , Jiang, Z. , and Cai, S. , 2017, “ Voltage-Induced Wrinkling in a Constrained Annular Dielectric Elastomer Film,” Trans. ASME J. Appl. Mech., 85(1), p. 011007.
A. Minori, S. Jadhav, Q. He, S. Q. Cai, M.T. Tolley, “Reversible actuation of origami inspired composites using liquid crystal elastomers,” Conference on Smart Materials, Adaptive Structures and Intelligent Systems, Snowbird, Utah, 2017.
K. Li and S.Q. Cai, "Modelling of Light-driven bending vibration of a liquid crystal elastomer beam," Journal of Applied Mechanics, vol 83, pp.1-6,2016.
Liang, X., Tao, F., and S. Q. Cai, “Creasing of an everted elastomer tube,” Soft Matter, 12, 7726-7730, 2016.
X. D. Liang and S. Q. Cai, "Gravity induced crease-to-wrinkle transition in soft materials," Applied Physics Letters, vol. 106, Jan 26 2015.
X. D. Liang, K. Li, and S. Q. Cai, "Drying-Induced Deformation in Fiber-Embedded Gels to Mimic Plant Nastic Movements," International Journal of Applied Mechanics, vol. 7, Apr 2015.
H. M. Wang and S. Q. Cai, "Cavitation in a swollen elastomer constrained by a non-swellable shell," Journal of Applied Physics, vol. 117, Apr 21 2015.
H. M. Wang and S. Q. Cai, "Drying-induced cavitation in a constrained hydrogel," Soft Matter, vol. 11, pp. 1058-1061, 2015.
X. D. Liang and S. Q. Cai,, "Shape bifurcation of a spherical dielectric elastomer balloon under the actions of internal pressure and electric voltage," Journal of Applied Mechanics, vol. 82, pp. 1-8, 2015.
K. Li, K. W. Ding, and S. Q. Cai, "Diffusion-induced wrinkling instability in a circular poroelastic plate," Applied Physics Letters, vol. 102, Jun 17 2013.

F. Weiss, S. Q. Cai, Y. H. Hu, M. K. Kang, R. Huang, and Z. G. Suo, "Creases and wrinkles on the surface of a swollen gel," Journal of Applied Physics, vol. 114, Aug 21 2013.
N. Zalachas, S. Q. Cai, Z. G. Suo, and Y. Lapusta, "Crease in a ring of a pH-sensitive hydrogel swelling under constraint," International Journal of Solids and Structures, vol. 50, pp. 920-927, Mar 15 2013.
S. Q. Cai, D. Y. Chen, Z. G. Suo, and R. C. Hayward, "Creasing instability of elastomer films," Soft Matter, vol. 8, pp. 1301-1304, 2012.
D. Y. Chen, S. Q. Cai, Z. G. Suo, and R. C. Hayward, "Surface Energy as a Barrier to Creasing of Elastomer Films: An Elastic Analogy to Classical Nucleation," Physical Review Letters, vol. 109, Jul 16 2012.
Y. C. Lou, A. Robisson, S. Q. Cai, and Z. G. Suo, "Swellable elastomers under constraint," Journal of Applied Physics, vol. 112, 2012.
K. Li, D. L. Ge, and S. Q. Cai, "Gravity-induced wrinkling of thin films on soft substrates," Europhysics Letter, vol. 100, Dec 2012.
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, vol. 59, pp. 1094-1114, May 2011.
L. H. Jin, S. Q. Cai, and Z. G. Suo, "Creases in soft tissues generated by growth," Euro. Phys. Lett., vol. 95, Sep 2011.
J. Zhu, T. F. Li, S. Q. Cai, and Z. G. Suo, "Snap-through Expansion of a Gas Bubble in an Elastomer," Journal of Adhesion, vol. 87, pp. 466-481, 2011.
S. Q. Cai, K. Bertoldi, H. M. Wang, and Z. G. Suo, "Osmotic collapse of a void in an elastomer: breathing, buckling and creasing," Soft Matter, vol. 6, pp. 5770-5777, 2010.
S. Q. Cai, Y. C. Lou, P. Ganguly, A. Robisson, and Z. G. Suo, "Force generated by a swelling elastomer subject to constraint," Journal of Applied Physics, vol. 107, May 15 2010.
R. Marcombe, S. Q. Cai, W. Hong, X. H. Zhao, Y. Lapusta, and Z. G. Suo, "A theory of constrained swelling of a pH-sensitive hydrogel," Soft Matter, vol. 6, pp. 784-793, 2010.
J. W. Yoon, S. Q. Cai, Z. G. Suo, and R. C. Hayward, "Poroelastic swelling kinetics of thin hydrogel layers: comparison of theory and experiment," Soft Matter, vol. 6, pp. 6004-6012, 2010
J. Zhu, S. Q. Cai, and Z. G. Suo, "Nonlinear oscillation of a dielectric elastomer balloon," Polymer International, vol. 59, pp. 378-383, Mar 2010.
J. Zhu, S. Q. Cai, and Z. G. Suo, "Resonant behavior of a membrane of a dielectric elastomer," International Journal of Solids and Structures, vol. 47, pp. 3254-3262, Dec 1 2010.
S. Q. Cai, Z. R. Li, and Y. M. Xia, "Evolution equations of deformation twins in metals - Evolution of deformation twins in pure titanium," Physica B-Condensed Matter, vol. 403, pp. 1660-1665, May 1 2008.