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The generation of stress-focusing features in confined elastic sheets

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Crumpling is the canonical example of stress focusing in a confined elastic sheet. Subject to a large biaxial confinement, the sheet must bend in multiple directions, which induces Gaussian curvature and therefore strain. This strain is best accommodated by focusing the stress into small regions. In a crumpled sheet, multiple stress-focusing features appear apparently randomly. Here, I present two systems in which stress-focusing features are created in a controlled manner. In the first, a thin sheet is floated on a droplet of water. As the curvature of the droplet is increased, first wrinkles and then a focused features appear on the edge of the sheet. In the second, a focused feature appears at the transition between wrinkle patters of two different wavelengths. The degree of the focusing can be controlled by the confinement, the thickness, and the tension applied transverse to the confinement.