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Scalloped Colloidal Membranes

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A number of essential processes in biology and materials science, such as vesicle fusion and fission as well as pore formation, change the membrane topology and require formation of saddle-splay surfaces. The energetic cost associated with such deformations is described by the Gaussian curvature modulus. We show that flat 2D colloidal membranes composed of achiral rods are unstable and spontaneously form scalloped edges. Quantitative analysis of this instability provides estimates of the Gaussian curvature modulus of colloidal membranes. The measured sign and magnitude of the modulus can be explained by a simple excluded volume argument that was originally developed for polymeric surfactants.

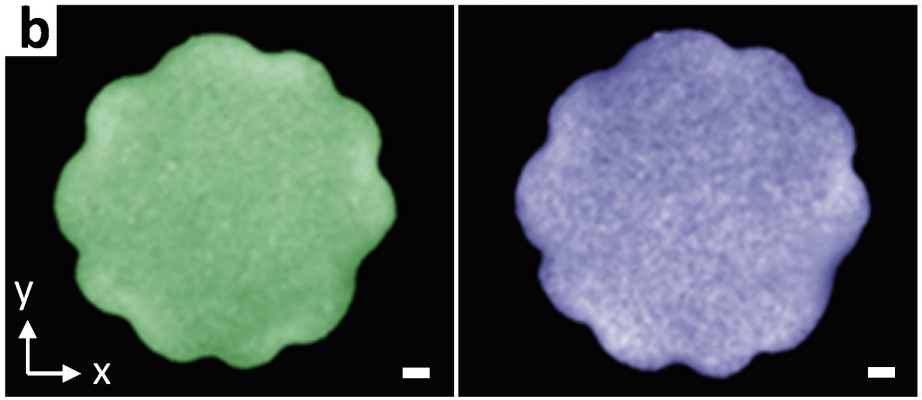

Image of a scalloped colloidal membrane, whose edge had periodically undulating 3D structure. The membrane is assembled from a mixture of one-micron long rods of opposite chirality, so that its effective net chirality is zero. Both rods are fluorescently labeled with two distinct dyes. The two images illustrate that the rods are uniformly mixed throughout the membrane interior. Scale bar is 3 microns.

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