Buckling of multicomponent elastic shells with line tension

Rastko Sknepnek, Graziano Vernizzi and Monica Olvera de la Cruz

Soft Matter (2012) **8**, 636

- We have used simulated annealing Monte Carlo simulations to determine optimal shapes and domain distributions of a two-component elastic shell over a wide range of inter-component line tensions, relative concentrations of the components, as well as relative bending rigidities.

- We found a rich gallery of shapes, including a number of polyhedral structures at moderate values of the line tension and the bending rigidity ratio.

- Our analysis shows that it is in principle possible to combine two materials with different elastic properties to construct a wide variety of shell shapes with potential applications in medical imaging, drug delivery, or composite material design.

- Our model assumes the presence of the 12 disclination defects originating from the construction of a crystal lattice on a sphere. However, our results suggest that the faceting into polyhedral shapes is not directly related to the defects, even though their presence introduces strain to the shell.

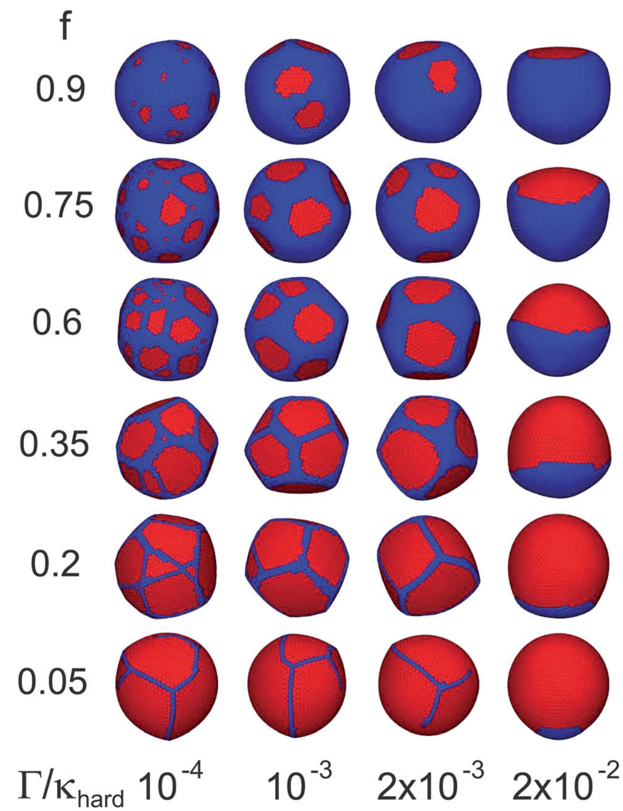

Figure: Gallery of representative shapes for a range of relative fractions of the soft component f vs. the dimensionless line tension Γ/κ_{hard} for $\kappa_{soft}/\kappa_{hard} = 0.03$. In the top row, the system is almost completely soft, and the icosahedral buckling is clearly evident. As the fraction of the soft component is reduced the icosahedral symmetry is lost, the soft component forms ridges and the shell buckles into a number of irregular polyhedra. The soft component is shown in blue and the hard component in red.

Supported by the US Department of Energy Award DEFG02-08ER46539 and the US Air Force Office of Research Award FA9550-10-1-0167.