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On shape and elasticity: bio-sheets, curved crystals, and odd droplets

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Stellingen

behorende bij het proefschrift

On Shape and Elasticity:
Bio-sheets, Curved Crystals, and Odd Droplets

1. The linear scaling of the dislocation number with the lattice size found for spherical crystals holds in general for any crystal of the same topology. The prefactor, however, depends on the crystal geometry and it decreases with increased Gaussian curvature around the topological disclinations.

   Chapter 3

2. Even when screened by dislocation scars, the stress field created by the topological disclinations in spherical crystals induces out-of-plane buckling, though this could be halted by high bending modulus or thermal effects such as increased entropy and changes in other material parameters.

   Chapter 3 and 4

3. The elasticity-driven faceting and the gravitational flattening of spherical liquid droplets are enabled by changes in the surface tension, which is modulated by temperature and by interfacial spontaneous curvature.

   Chapter 4

4. Cylindrical and helical shapes are prevalent in tubulin assemblies due to the spontaneous curvature and the anisotropy conferred by the asymmetries in dimeric conformation and interactions.

   Chapter 5

5. The dichotomy between triangular and quadrilateral emulsion platelets explored by Haas et al. does not require the presence of rotator layers, but it could be explained by curvature screening of merged topological disclinations and the renormalization of surface tension.

   P.A. Haas et al., Phys Rev Lett, **118** (2017).

6. Though adequately explaining the temperature-driven deformations of emulsion droplets, the initial mechanical models proposed by Denkov et al. and Guttman et al. did not explicitly address the size-dependent behavior of the spherical buckling, which proved to be a key factor towards a more complete model.

N. Denkov, et al., Nature, **528** (2015).
S. Guttman, et al., Proc Natl Acad Sci USA, **113** (2016).

7. Early work on the influence of the chemical environment and assisting proteins on the assembly of tubulin structures is largely phenomenological. Systematic studies are lacking, and they could further benefit current mechanochemical models of microtubule dynamics, such as that presented by Igaev and Grubmüller.

M. Igaev and H. Grubmüler, Proc Natl Acad Sci USA, **119** (2022).

8. Shape-shifting materials engineered for optical and soft matter applications, such as the work at U. Steiner's lab (Adolphe Merkle Institute), are based on uniform isotropic or anisotropic built-in stress, limiting the possible attainable shapes. Techniques for local sculpting, required to go beyond, could be improved with theoretical study of thin solid elasticity and stress-relieving deformations.

9. Unlike with physical wounds, psychological ones are not readily recognized and/or addressed. Therefore, we should bring the perception of, and approach to mental health to a similar dimension as those on physical health.

10. Climate change mitigation and adaptation will not come solely from individual action but they cannot happen without it. For many of us, this requires giving up the comfort of an unsustainable lifestyle, which in turn is challenged by an emotional distancing from the problem.

11. Similar to an art masterpiece, the various fascinating aspects of science are best appreciated at a suitable distance from them.

12. Team communication and the constant exchange of ideas moves the research process forward faster.

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