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Crack formation in drying suspensions

Crack formation in drying suspensions is a widespread phenomenon that leads to the formation of characteristic, self-organised fragmentation patterns. Drying suspensions tend to form such patterns across many orders of magnitude – from the micrometre scale in nanomaterials to the meter scale in geological systems. Prominent examples include drying varnishes and paints, as well as mud soils in desert landscapes.

The underlying mechanisms are based on the interaction of solvent evaporation, particle interactions, and the development of mechanical stresses as a result of shrinkage processes. During drying, the particle concentration increases continuously, forming a solid network. The resulting tensile stresses cannot be compensated elastically indefinitely and eventually discharge in the form of cracks. The resulting crack patterns reflect both material properties and boundary conditions such as layer thickness, substrate adhesion, and drying rate.

Understanding these processes is not only of fundamental physical interest, but also has high practical relevance for coating technologies, material design, and the control of structure formation in functional materials, e.g., in printable electronics.

The resulting patterns and characteristic size scales follow a hierarchy that is based on the temporal process of crack formation.