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Directed Assembly at Interfaces of Isotropic and Anisotropic Fluids

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We exploit fields inherent to soft materials that contain colloidal particles to induce interactions and to direct particles to assemble into well-defined structures at given locations. The unifying concepts are that colloidal particles create deformations that store energy in soft matter, and that soft matter can be molded to create energy fields with which the particle sourced deformations can interact. Furthermore, since soft matter can be readily reconfigured, these approached pave the way to reconfigurable structures. Two examples are presented. In one, we exploit curvature fields at fluid interfaces to generate capillary interactions that steer particles along curvature gradients to given locations. Anisotropic particles adopt preferred orientations and migrate to sites of high curvature. The role of different aspects of the particle-sourced deformation and the imposed curvature field in driving these orientations and migrations is discussed. In the second example, we exploit elastic energies that arise in confined liquid crystals. By confining a nematic liquid crystal in a structure with well-defined anchoring conditions, the nematic director and its associated defect field can be molded to store elastic energy. This energy steers particles within the bulk or particles trapped at the nematic-air interface. We demonstrate this concept by creating defect rings around immersed microposts in a nematic liquid crystal. Particles trapped at the nematic air interface interact with this energy field, forming assemblies mimicking the defect texture.