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Rearrangement of 2D clusters of droplets under compression: transition from crystal to glass

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A crystal and a glass are different at a molecular level which leads to strong consequences at the macroscopic scale. We have developed an ideal experimental system to model such structures. The 2D clusters are made of an emulsion of lightly attractive, stabilized oil droplets ($R \sim 10\ \mu m$) in water which are assembled droplet by droplet (tens of droplets). We study the response of the cluster when it is compressed between two thin glass rods ($R_c \sim 10\ \mu m$). One glass rod is used as a force transducer in order to measure the forces as the droplets spatially rearrange under compression. Coupling the optical microscopy images of structural rearrangements within the 2D cluster with the direct force measurements provides insight into the failure mechanisms. Perfectly ordered crystals (highly monodisperse droplets) show well defined transitions. As the number of defects (substitution of a droplet by a smaller one) is increased in the crystal, we can study the transition toward a glassy system (bidisperse cluster). Additionally, the impact of the size of the cluster, the geometry of the initial aggregate, the relative size of a defect or even its position can be studied.

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