CICLO DE SEMINARIOS 2020-2021
DEPARTAMENTO DE QUÍMICA FÍSICA
UNIVERSIDAD COMPLUTENSE DE MADRID

Viernes 12 de Marzo de 2021 – 12:30 h

Moulding hydrodynamic 2D-crystals upon parametric Faraday waves in shear-functionalized water surfaces

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Faraday waves, or surface waves oscillating at half of the natural frequency when a liquid is vertically vibrated, are archetypes of ordering transitions on liquid surfaces. Although unbounded Faraday wave patterns sustained upon bulk frictional stresses have been reported in highly viscous fluids, the role of surface rigidity has not been investigated so far. Here, we demonstrate that dynamically frozen Faraday waves—that we call 2D-hydrodynamic crystals—do appear as ordered patterns of nonlinear gravity-capillary modes in water surfaces functionalized with soluble (bio)surfactants endowing in-plane shear stiffness. The phase coherence in conjunction with the increased surface rigidity bears the Faraday waves ordering transition, upon which the hydrodynamic crystals were reversibly molded under parametric control of their degree of order, unit cell size and symmetry. The hydrodynamic crystals here discovered could be exploited in touchless strategies of soft matter and biological scaffolding ameliorated under external control of Faraday waves coherence.