Films of patchy particles far from equilibrium

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Patchy colloids with highly directional interactions are ideal building blocks to control the local arrangements resulting from their spontaneous self-organization. Here we propose their use, combined with substrates and nonequilibrium conditions, to obtain novel structures, different from those of equilibrium thermodynamic phases. We investigate numerically the irreversible adhesion of different types of three-patch colloids and Lisbon colloids, near attractive substrates, and analyze the network of connected particles that is formed, as well as the kinetic roughening of their interfaces.

We consider spherical three-patch colloids and study the dependence of the kinetics on the angle between the patches, in the limit of advective mass transport. We find that the growth is suppressed below and above a minimum and a maximum angle, revealing two absorbing phase transitions. While the transition at the minimum angle is continuous in the universality class of directed percolation, the one at the maximum angle is clearly discontinuous. In between, a colloidal network grows away from the substrate in the Kardar-Parisi-Zhang universality class.

Finally, we characterize the kinetic roughening of Lisbon patchy colloids in 2D and find that the robust KPZ universality class, changes to quenched KPZ, over a finite range of the colloids parameters. We analyze these results in the context of recent experiments on the structure of the films of adsorbed particles on evaporating drops.

[1] C. S. Dias, N. A. M. Araújo, and M. M. Telo da Gama. Phys. Rev. E 90, 032302 (2014).

[2] C. S. Dias, N. A. M. Araújo, and M. M. Telo da Gama. EPL 107, 56002 (2014).