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Self-assembly of active colloidal molecules with dynamic function
RODRIGO SOTO, Universidad de Chile, RAMIN GOLESTANIAN, University of Oxford — Catalytically active colloids maintain non-equilibrium conditions in which they produce and deplete chemicals at their surface. While individual colloids that are symmetrically coated do not exhibit dynamical activity, the concentration fields resulting from their chemical activity decay as 1/r and produce gradients that attract or repel other colloids depending on their surface chemistry and ambient variables. This results in a non-equilibrium analogue of ionic systems, but with the remarkable novel feature of action-reaction symmetry breaking. In dilute conditions these active colloids join up to form molecules via generalized ionic bonds. Colloids are found to join up to form self-assembled molecules that could be inert or have spontaneous activity in the form of net translational velocity and spin depending on their symmetry properties and their constituents. As the interactions do not satisfy detailed-balance, it is possible to achieve structures with time dependent functionality. We study a molecule that adopts spontaneous oscillations and another that exhibits a run-and-tumble dynamics similar to bacteria. Our study shows that catalytically active colloids could be used for designing self-assembled structures that posses dynamical functionalities.

Rodrigo Soto
Universidad de Chile

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