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Suppression of Ostwald Ripening by Chemical Reactions DAVID ZWICKER, Harvard University, ANTHONY A. HYMAN, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany, FRANK JÜLICHER, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — Emulsions consisting of droplets immersed in a fluid are typically unstable and coarsen over time. One important coarsening process is Ostwald ripening, which is driven by the surface tension of the droplets. Ostwald ripening must thus be suppressed to stabilize emulsions, e.g. to control the properties of pharmaceuticals, food, or cosmetics. Suppression of Ostwald ripening is also important in biological cells, which contain stable liquid-like compartments, e.g. germ granules, Cajal-bodies, and centrosomes. Such systems are often driven away from equilibrium by chemical reactions and can thus be called active emulsions. Here, we show that non-equilibrium chemical reactions can suppress Ostwald Ripening, leading to stable, monodisperse emulsions. We derive analytical approximations of the typical droplet size, droplet count, and time scale of the dynamics from a coarse-grained description of the droplet dynamics. We also compare these results to numerical simulations of the continuous concentration fields. Generally, we thus show how chemical reactions can be used to stabilize emulsions and to control their properties in technology and nature.

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