Dried Foam Film: Self-Standing, Water-Free, Reversed Bilayers

Foam films and lipid membranes are typical two-dimensional assemblies of amphiphiles with an inverse molecular arrangement. In contrast with the lipid membranes spontaneously formed in water, the thin foam films are made of a water layer sandwiched by two layers of amphiphiles directing the hydrophobic moieties outside. The first systematic investigations on thin foam films was performed by Issac Newton three centuries ago. Such foam films were also named Newton Black Films (NBFs). The research of foam films were then followed by the discoveries of Langmuir Film, Black Lipid Membranes (BLMs), Self-Assembled Monolayers (SAMs), and so on. So the understandings of foam films built up the foundation of colloid and interfacial chemistry and led to the wide application in modern industry.

Thin foam films are usually formed in open frames placed in a sealed cell that is filled with saturated vapor. The films are stable, so long as water exists in the interstitial space. However, they were so transient in ambient air that the interstitial water molecules have been long deemed to be indispensable to keep the structure. However, we found that some kinds of foam films maintain their structure even after completely drying. These self-standing, water-free, reversed bilayers were obtainable from aqueous or organic solutions in air. Such films are composed of two molecular layers of amphiphilic compounds without interstitial hydration water. From a structural point of view, the "Dried Foam Films" can be considered a new class of organized molecular.