Synthesis and Assembly of Polyester Microdroplet Protocells

How modern life emerged initially remains an unanswered mystery in science. In particular, understanding how the first cells on Earth (also known as protocells) assembled would be a significant step towards answering this question. Recently, compartments generated from liquid-liquid phase separation (LLPS) phenomena have been proposed as protocell models.

One of these prebiotically plausible LLPS protocell models are polyester microdroplets, which have been the focus of recent international media reports. Polyesters in gel form can be synthesized through dehydration synthesis of $\alpha$-hydroxy acid ($\alpha$HA) monomers under mild heating conditions ($60-100^\circ C$). These polyesters can be either homo- or heteropolymers, and the reaction products are polydisperse mixtures, rather than single products.

Upon rehydration of polyester gels in aqueous media, microdroplets assemble via LLPS. These polyester microdroplets are spherical and membraneless, and allow free exchange of various molecules and biomolecules, including fluorescent dyes and RNA. The function of proteins and ribozymes is also not completely inhibited in the presence of these droplets.

Further increasing the chemical complexity of polyester microdroplets through incorporation of a basic $\alpha$HA into the polymers yields potentially cationic droplets. Even incorporating as little as 20% charged residues allows previously neutral droplets to acquire the ability to more strongly segregate RNA.

Future work will focus on further elucidation of the functional properties and stability of polyester microdroplets, while also exploring their potential biomedical applications such as drug delivery vessels.

3) T. Z. Jia et al., Biomacromolecules. 2021, 22, 1484.

Tony Z. Jia Earth-Life Science Institute, Tokyo Institute of Technology
© 2022 The Chemical Society of Japan