Fabrication and Characterization of Tubular Artificial Tissues Composed of Multiple Liposomes via Salt Bridges

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Keywords: Liposomes; Vesicles; Artificial Cells; Artificial Tissues; Tubular Structures

Multicellular organisms have hierarchical structures where multiple cells assemble to form tissues, resulting in complex 3D structures. Inspired by them, creation of artificial tissues composed of multiple artificial cells could lead to novel bioinspired materials.[1] We previously found the formation of artificial tissues composed of multiple liposomes by designing salt bridge intermolecular interaction.[2] Next, since controlling shapes is one of the important factors as materials, we have succeeded in developing new techniques to fabricate the artificial tissues into fibrous shapes.[3] As the next step towards more complex structures, tubular structures are focused on because they have holes in which solutions can be penetrated, which has a potential to be used as flow reactors. In this study, we report methods to fabricate liposome-based artificial tissues into tubular shapes and their functionalities.

Liposomes containing amphiphilic amines or carboxylic acids were mixed to obtain assemblies of multiple liposomes via salt bridges. The liposome assemblies were loaded tightly into a pipette tip under centrifugation. A rod representing a core was then inserted into the center of the pipette tip to function as a hole, and the liposome assemblies were pushed with a mechanical pipette to obtain a liposome-based tubular artificial tissue. The tubular structure was confirmed by using image analysis of brightness under high-intensity light irradiation, where gray values decreased at the center of the artificial tissue, indicating the formation of a hole. We will report the precise shape controllability of the tubular structures, such as the size of the holes, and their functionalities as flow reactors.

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