PACIFICHEM 2015 Conference
Honolulu, HI
December 15-20, 2015

New Perspectives of Synthetic and Biological Soft Matter
Abstracts

Enzyme instructed supramolecular self-assembly in biological environment for biomedical applications

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Supramolecular structures constructed from small molecules such as peptides could be used to develop smart materials for future applications in tissue engineering, regenerative medicine, and drug delivery. In these systems the sol-gel transition is initiated by physical or chemical stimuli. In the present work we use an enzymatic hydrogelation strategy to develop a novel molecule that self-assembles in the biological environment in the presence of phosphatase. First, we verify that self-assembly process occurs inside living mammalian cells using various techniques such as fluorescent microscopy and transmission electron microscopy. Supramolecular self-assembly occurs on the surface of the endoplasmic reticulum, where the dephosphorylation activity is most pronounced. Second, we demonstrate that the small molecules can also self-assemble in living mice bearing HeLa tumor in which the phosphatase is over-expressed. Since self-assembly can also incorporate guest molecules into nanofibers, fluorescent imaging was made to reveal that supramolecular assemblies prolong the retention of a photo thermal therapy agent (ICG) within the tumor site. The in situ formation of supramolecular structures not only shows its spatiotemporal specificity but also minimizes the accumulation of therapeutic agents in the healthy part of the body, which is important for potential biomedical applications.