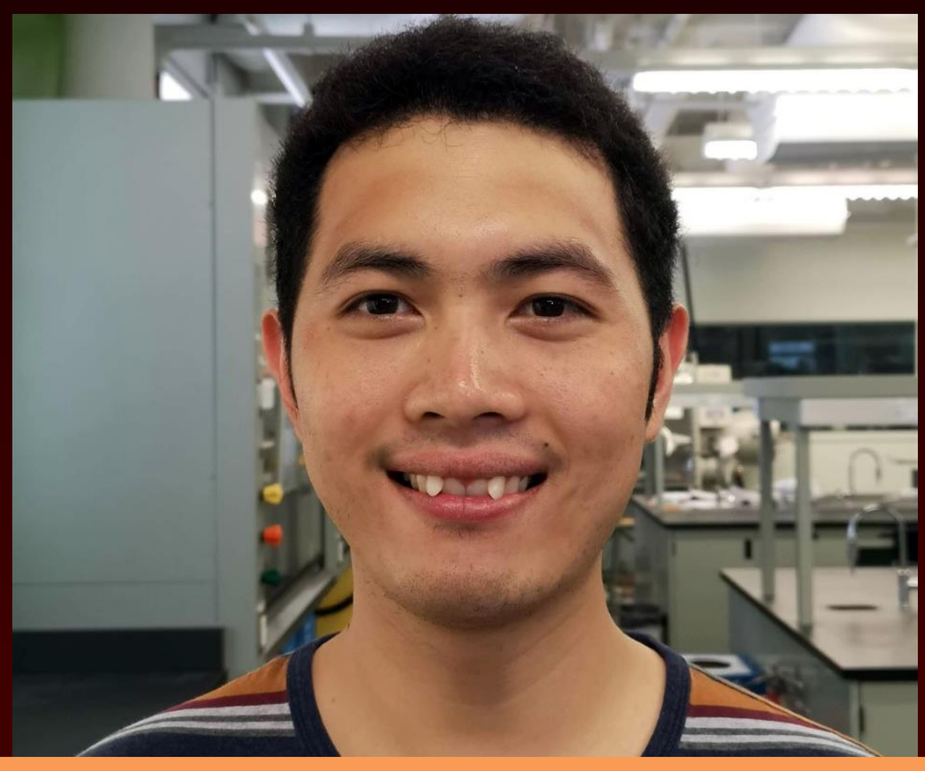
Biomedical Engineering Seminar Series

1st Semester, Academic Year 2018

Date: August 21, 2018
Time: 10.00 AM – 11.00 AM
Room 6373, 3rd level, Building 3,
Faculty of Engineering; Mahidol University



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"Hierarchical and synergistic assembly of amphiphilic DNA nanostructures"

DNA assembly offers a powerful molecular tool to create arbitrary structures with excellent size and shape control through selective assembly, sequence programmability and well-defined, rigid structure of DNA. As designer scaffolds, DNA materials have a tremendous potential for precise organization of molecules into any pattern. In most DNA-based constructions, Watson-Crick base-pairing serves as the only instruction rule. However, their efficiency can reach a limit when the design complexity increases. As a unique approach, supramolecular DNA assembly has emerged from the deliberate blend between the toolbox of supramolecular chemistry and DNA programmability to address this complexity-efficiency issue and to generate new structures and functions. The aim of this thesis is to integrate hydrophobic interactions as orthogonal instruction rules in the design and assembly of amphiphilic DNA nanostructures, through the use of small molecule- and polymer-DNA conjugates. Firstly, polymer-DNA conjugates are anisotropically organized on DNA cages. The polymer association modes are directed by their decoration geometry on DNA cages. A library of well-defined, hierarchical amphiphilic DNA nanostructures can be generated by polymer's sequence regulation. Secondly, to demonstrate the versatility of DNA cages in the structure-function design, multiple cholesterol units are site-specifically organized on DNA cubes to allow their binding to lipid vesicles. The membrane interactions of these nanostructures are dependent on the decoration geometry as well as structural flexibility. Finally, to further improve the stability of hydrophobic interactions, three chemical approaches are developed to crosslink the hydrophobic micellar cores of amphiphilic DNA nanostructures. Overall, the work presented herein demonstrate that there is a synergy between DNA base-pairing and hydrophobic interactions that lead to new or even unprecedented structural and functional modes of amphiphilic DNA nanostructures. The opportunity from this work could not only contribute to a better fundamental understanding of self-assembly, but also provide guidelines to rationally design target structures, which could facilitate the development of advanced materials for applications in materials science and biomedicine.

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