DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

PhD Thesis proposal

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Crystallization-driven complex polymeric nanoparticles

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Abstract

Crystalsome is a newly developed polymorphic nanoparticle formed by polymer solution crystallization on the liquid/liquid interface of Mini emulsions. The structure is formed by a splayed single crystal wrapping onto a spherical shell whose size ranges from 100nm to several micrometers. In previous works, the highly crystalline shell has been proven to have strong mechanical stability, low permeability for loaded small molecules in the shell, and outstanding blood retention time. This dissertation proposal aims to push forward the application of this novel material. In this proposal, we discuss methods to stabilize the Nanoemulsions and slow down the destabilization dynamic to improve the size distribution of the final product. Based on the improved emulsion system, studies on exploring crystalsome formation process are planned. This process is found to be more complex process than a confined solution crystallization of polymers. Estimation based on crystalsome shell thickness shows the amount of polymer in emulsion droplet is insufficient to form a complete shell. Two hypotheses and several experiments are proposed to help understand the origin of the extra polymer. Besides the formation mechanism, understandings of this emulsion system are utilized to design special crystalsomes for drug delivery: crystalsomes with a narrow size distribution, high water dispersibility, low cost, and high mechanical stability.