Poster

DESIGN AND SYNTHESIS OF SUPRAMOLECULAR HYDROGELS FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

Motivation: Only a few cells in the human organism keep their ability to regenerate. Hence, modern medical research intends to develop new ways to cultivate these cells with high regenerative capacity with the aim to reconstruct damaged organs and tissues. This is a challenging process currently carried out in 2D cultures, which do not reflect the in vivo conditions for cell growth and differentiation. Thus, recent studies are trying to get 3D cultures in order to reproduce the conditions that take place during development [1]. Moreover, 3D culture is applied for investigating cellular physiology, stem cell differentiation, and tumor models for studying interaction mechanisms between the extracellular matrix and cells [2].

This project aims to design and synthesize different biocompatible supramolecular hydrogels which emulate the extracellular matrix, and their use as scaffold for 3D cell growth. Moreover, the prepared supramolecular hydrogels could act as nanocontainers for the encapsulation of biomolecules and drugs, promoting growth, adhesion and cell differentiation.

Methods and results: Within this project, four diacetylenic based glycolipids [3] have been designed and synthesized as responsive and self-organizing monomers by different synthetic routes. Self-association studies show that two of the four monomers generated 1D-tubular microstructures that hierarchically aggregate in water affording novel hydrogels, that expose a dense layer of carbohydrates to the water phase much like the glycocalyx at the cell membrane. The structure of the monomers has been determined by 1H NMR, 13C NMR, and high resolution mass spectroscopy, while aggregation and self-assembly of the formed nanomaterials have been investigated by transmission electron microscopy (TEM), scanning electron microscopy (SEM), and atomic force microscopy (AFM).

Conclusions: From the work carried out in this project, the following conclusions can be drawn: Firstly, the synthetic design of the amphiphiles, based on the use of copper catalyzed azide alkyne cycloaddition [3] in order to enhance the stacking between the monomer in the supramolecular state in order to induce the gelation has been validated. And secondly, photo-polymerization of obtained nanomaterials leads to the formation of conjugated poly(diacetylene) backbones of alternating enyne groups which rigidify the glyconanomaterials, thus enhancing their physical stability, a critical issue for their future medical uses.

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