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New Sensitive Vesicles Designed by Living Polymerization for Artificial Cells Development †

Ionut-Cristian Radu [1,*], Catalin Zaharia [1], Andra Onas, Eugeniu Vasile [2], Andreea Vadureanu [1]

[1] Advanced Polymer Materials Group, University Politehnica of Bucharest, Bucharest, Romania
[2] University Politehnica of Bucharest, Bucharest, Romania
* Correspondence: radu.ionucristian@gmail.com (I.C.R.);
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Abstract: Nanotechnology has been attending much attention since 1980s and has been adapted into many engineering fields. In particular, nanotechnology has led to significant progress in a biomedical fields such as controlled drug/gene delivery, tissue engineering, imaging of specific sites, and probing of DNA structure. Compartmentalization is crucial for life to occur. Almost all cells, be it eukaryotic or prokaryotic, consist of an outer protective vesicle containing the vital organelles needed to carry out a specific role in the body. Compartmentalization provides a secure environment to facilitate essential biological processes such as DNA replication and aerobic respiration. Along with the rapid development of cell biology, many issues have arisen mainly because of the inherent complexity of biological cells and the frangibility, easy loss of activity, or death *in vitro*. To overcome these issues while still mimicking biological cells, artificial cells are built. The construction of typical artificial cells is considered one of the pillars of synthetic biology. Research on these synthetic cells has many purposes, such as (i) providing a way to investigate and understand cellular life; (ii) connecting the non-living with the living world; (iii) adding new functions which are absent in biological cells for the development of new applications; (iv) providing a plausible theory for the origin of life [1,2]. In this study, we design a new smart compartmented vesicle-in-vesicle system by assembling modified protein and natural polyester molecules. The protein biofunctionalization involves a grafting modification with side synthetic chains responding to temperature and pH stimuli. The protein engineering biofunctionalization proposes a controlled live living polymerization based on atom transfer radical polymerization (ATRP). The synthesis pathways generate complex macromolecular structures able to exhibit a sensitive behavior. These nanoparticles represent the compartmented organelles within the artificial cell system. The natural polyester is modified with various synthetic blocks to generate an amphiphilic behavior. The multiblock copolymer represents the work molecule for cell membrane development. In conclusion, we reported the development of new polymeric self-assembled vesicles with thermal, pH, and ionic sensitivity for drug-loaded nanoparticle testing. The artificial cell development via compartmented vesicles approach is a new concept that may be a powerful tool in the future for carrying testing within cancer therapy and management.

Keywords: nanotechnology; ATRP; modern cancer therapy; artificial cells.

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Conflicts of Interest

The authors declare no conflict of interest.