Various architectures of star polymers based on PEO, as a model system for the delivery of nucleic acids

Katarzyna Szcześniak[a,b,c], Monika Makrocka-Rydzyk[b], Anna Woźniak[a], Marcin Jarek[a], Łukasz Popenda[a], Hong Y. Cho[c], Stefan Jurga[a,b], Krzysztof Matyjaszewski[c]

[a]NanoBioMedical Centre, Adam Mickiewicz University, Umultowska 85, 61-614 Poznan, Poland
[b]Department of Macromolecular Physics, Faculty of Physic, Adam Mickiewicz University, Umultowska 85, 61-614 Poznan, Poland
[c]Department of Chemistry, Carnegie Mellon University, 4400 Fifth Avenue, Pittsburgh, Pennsylvania 15213, USA
k.wegner@amu.edu.pl

Abstract
In the times of the harmful effects of the external environment on our bodies, many genetic diseases appear which results from our way of life and the influence of environment. Therefore, it becomes extremely important to discover and to synthesize the new materials that could prevent these diseases as well as to study the effects of such nanoparticles on compounds of natural origin - biomolecules. The method which involves the nanoparticles as modern vectors for transfection is known as gene therapy. We want to report the preparation of poly(ethylene glycol) (PEG)-based star polymers by an ATRP method. Our strategy in this area is to construct the efficient, biocompatible polymeric carriers for nucleic acids delivery using PEG-based star polymers with a cationic and degradable core. Four different architectures are considered including: multi-arms stars with biodegradable, and cationic core; 4-arms with biodegradable, cationic arms; linear polymers which are equivalent with other architectures in terms of molecular weight and chemical composition. Their structural characteristics were characterized by various methods such as DSC, NMR, NMR diffusion, DLS, microscopic techniques such as SEM, TEM) and polarizing optical microscopy (POM). The biological investigations were revealed on porcine skin fibroblast NT14 cell line. Methodology involved WST-1 proliferation assay and bioimaging INCell Analyzer 2000 system. Experiments carried out by DSC allowed the determination of the thermodynamic parameters of the synthesized polymers, i.e. melting and crystallization temperatures as well as their degree of crystallinity. DLS and NMR measurements were used to determine the sizes of star polymers in solution, and the behavior of the polymers in the solution was characterized by determining the diffusion coefficients. The investigation shows, that there is no cytotoxic effect in analyzed range of polymer concentrations in biological schemes. These results lead to the conclusion, that star polymers represent high biocompatibility profile, which enable their use in biomedicine. Thanks to extensive research, the cationic, biodegradable star-shaped polymers were obtained and their physical and chemical properties were investigated. Combined results of carried out measurements have allowed us to select the most suitable and promising candidates as nonviral vectors for gene therapy.

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References
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Figures

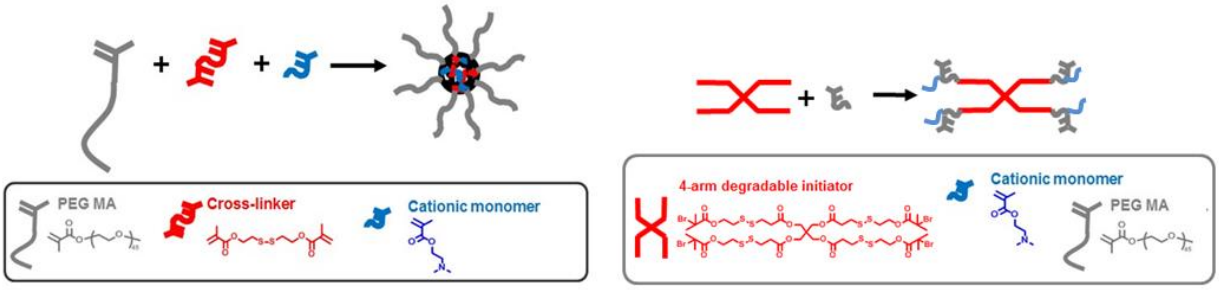

Fig. Structures of synthesized star polymers