Gene therapy - the introduction of genetic infromation to the cells via the therapeutic nucleic acids may become one of the most powerful ways of treating genetic disorders such as cystic fibrosis, Parkinson's disease, hemophilia, diabetes and cancer.
In gene therapy, nucleic acids can be delivered alone or as a complexes with virus or viral (synthetic) carriers, so called vectors. in order to enhanced or attenuate of gene expression. To initiate the expression of the encoded gene, ie. the process of transcription and translation of genetic information, the nucleic acid has to dissociate from the complex and reach the nucleus.
Transfection efficiency of the uncomplexed nucleic acids is low because they are rapidly destroyed in the interior of the cell. Among tested synthetic vectors, the promising group are polymeric carriers. They are less immunogenic than viral carriers and are relatively easier to prepare. However, many problems associated with the therapeutic effects of polymeric carriers still remains unresolved. Currently, the most important aspect in gene therapy is to prepare efficient and specific gene carrier that do not cause harmful side effects. To increase the efficiency of the transfection, nucleic acids or their complexes, for example with polymers, are deposited on the solid substrate. The surfaces used for this purpose support the organization and differentiation of cells, while immobilized nucleic acid provides genetic information substantial for the cells.
The aim of the project is to develop new thermosensitive polymer layers based on structures with star topology, as therapeutic delivery systems of nucleic acids into the cells, with their simultaneous culture and subsequent detachment without damage.
Due to the lack of reported studies on the preparation, characterization and application of star polymer surfaces (layers) of this type, this project will contribute to expand the knowledge on the subject through:

- the preparation of thermosensitive star polymer layers using „grafting to" method and their characterization
- the preparation and characterization of star polyplexes
- the deposition of the polyplexes on thermoresponsive polymer layers
- the studies of adhesion, proliferation, transfection and detachment of selected cell line

Thermosensitive star layers based on of poly(oligoethylene glycol methacrylate) will be synthesized in the project. Star-shaped polymers of defined structure (number and length of the arms) will be obtained by controlled atom transfer radical polymerization (ATRP) using the "core first" method. The epoxy modified arms of the star will react with functional groups introduced into the glass and silicon substrates leading to covalent attachment of polymer to the substrate ("grafting to" method). The obtained surfaces will be characterized by modern measurement methods (quartz microbalance, ellipsometry, FTIR, AFM, TEM). At the same time, nucleic acid complexes with polycationic star polymers, so called polyplexes, will be prepared. The stars used for complexation will contain the polycationic segments of poly(N,N-dimethylaminoethyl methacrylate) in the arms. Obtained polyplexes will be deposited on the star surfaces using thermosensitivity of the layers and/or polyplexes. The final task of the project will involve the study of adhesion, proliferation, and transfection of selected cells on synthesized polymer layers. After transfection step, thermosensitive star layers will ensure efficient detachment of the cells, controlled only by change of the temperature. Most importantly, the cultured cells would be detached without any damage, which occurs with enzymatic or mechanical detachment.
The innovative nature of the proposed project is the design of the star surfaces for immobilization of polyplexes and the use of thus obtained thermosensitive tool for culturing and non-invasive detachment of the transfected cells.
The project is an attempt to respond to the progress observed in the field of gene therapy and its potential use in medicine.