

Plastic Antibody

Nearly one million patients, i.e., 10-15% of pairs in reproductive age, suffer from fertility problems in Poland. Huge scale of these problems results, inter alia, in the negative birthrate in our country. These problems indicate how important is the development of new diagnostic tools for determination of fertility hormones. The global endocrine (includes follicle stimulating hormone and luteinizing hormone) testing market size was valued at USD 6.5 billion in 2015 and is expected to grow at a CAGR of 8% over the forecast period. High diversity in hormone concentration reduces the value of single test analysis and indicate the need of hormone profiling. Introduction of easy-to-operate, user-friendly, and cost-effective test kits for point-of-care (POC) diagnosis, can increase effectiveness and reduce costs of fertility problems treatment. Feasible and accurate hormonal testing is presumed to allow more effective causative treatment and reduce high-cost approaches based on artificial reproductive technologies (ART).

Two-time Nobel Prize winner, L. C. Pauling, said that molecular recognition in living organisms, i.e., the ability to recognize one molecule by another is one of the greatest mysteries of life. In the course of billions of years of evolution, Mother Nature has developed highly efficient methods for specific molecular recognition (antigen-antibody, enzyme-substrate, histon-DNA, etc.). As a main objective of the Project, we intend to imitate animated Nature and to develop synthetic *smart materials* capable of molecular recognition using molecular imprinting. For this purpose, first, a complex of a molecular template, which is mostly the determined substance itself, with functional monomers should be prepared. Subsequently, after the addition of cross-linking monomers, the complex is polymerized. In effect, we obtain a polymer with the template molecules entrapped in it. Finally, after their removal, empty molecular cavities are left in the polymer. With their shape and size, these cavities match the molecules used for imprinting. In other words, we get a kind of "a yeast cake with raisins picked out." Molecularly imprinted polymers (MIPs), so called "**plastic antibodies**", are able to selectively recognize and bind molecules of chosen substances, even in the presence of other substances with a similar structure.

Deposition of thin MIP film directly on a transducer surface is a crucial step of chemosensors fabrication. However, molecular imprinting encounters a number of difficulties. Their overcoming is associated with the solution of several important basic research problems. For instance, the sensitivity of a chemosensor with a continuous (non-porous) MIP film as a recognition unit is limited, mostly because of slow analyte diffusion through this polymer film. Herein, in this project we propose simple methods to enhance, in a controllable way, the active surface area of imprinted polymer film. We plan to introduce few new strategies of nanostructurezation of MIP films. One strategy consisting preparation of hierarchical sacrificial nanotemplate that will provide control over the MIP structure on three size scale levels. Other approach will involve synthesis of nanowires and nanofibers of MIPs.

Our interdisciplinary pioneering Project combines materials science, polymer chemistry, analytical and supramolecular chemistry. The most important result of its implementation will be to gain new knowledge enabling to develop artificial chemical recognition by molecular imprinting and use this knowledge to create new recognizing units of chemosensors for protein hormones. This will enable us to devise and prepare a new generation of these devices. The technological advancements in endocrine testing will aid the overall industry growth. For instance, the introduction of easy-to-operate test kits will facilitate the penetration of home-based diagnosis, which will be user-friendly and cost effective.