

### **Project 3.9. Localization and determination of redox activity in biological cells**

**Promotor:** Prof. dr hab. Marcin Opałło /dr Wojciech Nogala

**ICP PAS Group:** Nanoelectrochemistry

**WWW:** <http://groups.ichf.edu.pl/nogala>

#### **Background:**

Biological cells exhibit catalytic redox activity due to enzymes present on their membranes and/or inside the cells. For example, the red blood cells contain enzymes which protect them against oxidative damage by reactive oxygen species such as hydrogen peroxide. These enzymes catalyze disproportionation of hydrogen peroxide to water and dioxygen. This can be easily detected by evolution of gaseous dioxygen from cells exposed to reactive oxygen species. Another cellular redox activity is ability of cells to oxidize or reduce various reactants (reducing or oxidizing agents) by respiratory complexes present in the cells. E.g. the ability of some bacterial cells to reduce hexacyanoferrate species is known. *Escherichia coli* bacteria can regenerate the redox mediator (oxidized or reduced), what can be detected by feedback mode scanning electrochemical microscopy (SECM). Such an analysis in nanoscale is not straightforward due to the need for maintaining distance between the nanoelectrode SECM tip and the analyzed biological cell. To overcome this problem hopping probe approach methodology will be applied. We will study the influence of antimicrobial agents, inhibiting cellular respiration and destroying their membranes, on redox activity and topography of single bacterial cells. Differentiation between cancerous and normal cells based on their redox activities as well as monitoring of cancer cells are also planned.

#### **Aim:**

The main objectives of this project are evaluation of redox catalytic activity of individual biological cells and elucidation of spatial distribution of redox catalytic sites within individual cells and at their interfaces with surrounding fluids. This requires development of methodologies of sample preparation and nanoscale imaging of biological systems based on scanning electrochemical microscopy and scanning ion conductance microscopy.

#### **Requirements:**

- Master's degree in chemistry, physics, biology, pharmacy or engineering
- Good knowledge of English (Polish is not mandatory)
- Experience in experimentation
- Participation in scientific projects
- Self-motivation for scientific work
- Readiness to solving problems by oneself