Abstract
The aim of this thesis was the development of preparation procedures and study of the electrochemical properties of electrodes modified with hydrophilic carbon nanoparticles and enzymes. The carbon nanoparticles were immobilized onto electrode surfaces via the application of various methods like chemically and electrochemically generated sol-gel processes and/or layer-by-layer assembly. In the latter method the electrostatic interactions between negatively and positively charged carbon nanoparticles or between negatively charged carbon nanoparticles and imidazolium functionalized silicate were utilized for film formation. The obtained films were characterized by atomic force microscopy, scanning electron microscopy and reflection absorption infrared spectroscopy.

On the surface of modified electrodes redox active enzymes such as laccase, bilirubin oxidase, myoglobin and glucose oxidase were immobilized. Most of electrodes modified with laccase or bilirubin oxidase exhibit mediated and mediatorless bioelectrocatalysis of oxygen reduction. This reaction was studied by scanning electrochemical microscopy. The application of redox competition mode enabled the study of the catalytic activity of laccase co-encapsulated with carbon nanoparticles within silicate matrix. The electrodes modified with laccase or bilirubin oxidase were applied as biocathodes in Zn-dioxygen hybrid cells. In turn the direct signal from the enzyme’s active center was recorded for the electrodes modified with myoglobin and glucose oxidase. The effect of the presence of hydrogen peroxide or glucose on the electrochemical properties of these electrodes was also observed.