

Fundamental electrochemical processes and technologies

➤ **Rearrangement processes in the electrochemical double layer**

Study of the structure and dynamics of the electrochemical double layer at the metal-electrolyte interfaces with a view to identify the other-than-electrostatic interactions therein. Survey of the equations and laws of electrode kinetics to transform them compatible with modern forms of impedance spectroscopy.

➤ **Molecular electronics**

Development and application of single organic molecule conductivity measurement techniques based on the fine movement of atomic break junctions implemented either in stand-alone mode (MCBJ – Mechanically Controllable Break Junction), or scanning tunneling microscope (STM-BJ – STM Break Junction).

➤ **Metal dissolution / Corrosion protection**

Inhibition of dissolution and corrosion of metals with ordered and self-assembled protective coatings. Investigation of corrosion processes under biofilms.

Development of wastewater treatment technologies based on the adsorption properties of high surface-area colloidal hydroxide suspensions formed electrochemically in controlled dissolution of metallic ions.

➤ **Electrocatalysis**

Study of heterogeneous catalytic process coupled with charge transfer at the phase-boundary in the development and testing of multi-metallic systems.

➤ **Electrochemical energy storage**

Utilization of electric energy stored in the electric double-layer capacitor (“supercapacitor”). Characterization of the electric properties of high surface area carbon based supercapacitors (carbon sheets and/or carbon nanotubes), hybrid supercapacitors, and accumulators.

Ongoing projects

- OTKA NN128168 – Dynamic electrochemical impedance spectroscopy (DEIS). Development of a measurement system and its use for the study of the electrochemistry of platinum (2018–2024) – *principal investigator*
- HAS Hungarian-Czech collaboration – Charge transport studies in molecular redox switches and memristors (2022–2023) – *principal investigator*

Completed projects

- VEKOP-2.3.2-16-2017-00013 – Excellence in materials science: development of environmentally friendly processes for the efficient use of renewable energy and raw material sources and the controlled release of their energy content (2017–2021) – *participant*
- OTKA K-112034 – Frequency dependent double layer capacitors (2015–2017) – *principal investigator*
- FP7 PLIANT 309530 –, Process line implementation for applied surface nanotechnologies (2013–2017) – *participant*
- NVKP-16-1-2016-0045 – Development of an innovative photo-oxidation wastewater treatment technology for the removal of organic micro-pollutants from biologically purified wastewaters (2017–2019) – *participant*
- HAS Hungarian-Czech collaboration – Electron transport in single molecule junctions. Direct measurement of electrical and thermoelectric currents using break junction techniques. (2015–2017) – *principal investigator*
- Electrochemical double layer in ionic liquids (MÖB-DAAD – Universität Ulm (2013–2016) – *principal investigator*
- OTKA K-67874 – Environmental electrochemistry (2008–2012) – *principal investigator*
- FP7 N2P CP-IP 214134-2 – Flexible production technologies and equipment based on atmospheric pressure plasma processing for 3D nanostructured surfaces (2008–2012) – *participant*
- KTIA-AIK-12 – Scientific background of innovative techniques for the development of unconventional use of renewable energy sources and up-to-date energy storage tools (2013–2015) – *participant*
- KMR_12-1-2012-0386 – Local treatment of leachate of communal waste plants with a single innovative and chemical-free process (2012–2016) – *participant*