In the face of growing energy demands and global efforts to reduce greenhouse gas emissions, the development of green hydrogen production technologies becomes increasingly important. One of the primary challenges in this field is to enhance the efficiency of water electrolysis process, especially in terms of oxygen evolution reaction (OER), which requires high energy input and thus significantly impacts hydrogen production costs. This work aims to develop innovative anodic materials that would exhibit high catalytic activity and stability along with relatively low manufacturing costs.

The study focuses on modifying selected base materials, such as nickel foam, carbon fibre and graphite. These materials were nanostructurally activated with transition metals, such as cobalt, molybdenum, nickel and iron, in order to increase their active surface area and improve their catalytic properties. Undertaken research activities demonstrate that introduction of appropriate material modifications could considerably reduce the overpotential of the OER reaction, leading to lower electricity consumption in the electrolysis process, thus enhancing its overall efficiency.

Moreover, employment of more abundent materials instead of costly noble metals offers a viable economic alternative, enabling scalability and industrial application of the proposed solutions. The findings indicate that suitably modified base materials could significantly improve the hydrogen production efficiency, making it a competitive renewable energy source. This work contributes to the advancement of energy storage technologies and alternative fuel production, supporting global energy transition efforts.