

The main focus of this master thesis is the investigation of the anode catalysts for the Proton Exchange Membrane Water Electrolyzers (PEM-WEs). PEM-WEs play a pivotal role in the hydrogen economy concept as they allow water decomposition into oxygen and hydrogen. However, their operation requires expensive noble metal catalysts, i.e., iridium or platinum. This issue has yet to be solved to mass-produce PEM-WEs. Consequently, our main objective is to reduce the amount of iridium on the anode of PEM-WEs. We addressed this objective by two distinct approaches: morphological and chemical. With the morphological approach, plasma etching of the membrane and the magnetron sputtering of  $\text{CeO}_2$  served to increase the membrane's active surface. Hence we improved the catalysts utilization. With the chemical approach, we focused on the catalyst itself. Thus, we replaced the pure iridium catalyst with a bimetallic iridium-ruthenium one. Therefore, the activity of the catalyst was enhanced while its price got reduced. To explain and describe the catalyst's behavior, we used various electrochemical methods and surface analysis techniques. Finally, we combined both approaches to obtain one active, stable, and low-iridium-loading anode catalyst for PEM-WE.