ELECTRODE FABRICATION METHOD USING RESIN AND STEREOLITHOGRAPHIC 3D PRINTING

Rokas Bagdonas[1], Inga Morkvėnaitė-Vilkončienė[2]

[1]Vilnius Gediminas Technical University, Faculty of Mechanics, Department of mechanical and materials engineering
[2]Vilnius Gediminas Technical University, Faculty of Elektronics, Department of Electrical Engineering
rokas.bagdonas@vilniustech.lt

The microelectrodes used in scanning electrochemical microscope (SECM) measurements are usually made using a glass shell, which provides good insulating and mechanical properties. However, such electrodes are brittle and expensive, and manual manipulation of the electrode during the measurement, in particular positioning and surface modification, presents a high risk of damage, and the geometry and shape of the glass shell electrodes are practically fixed, making them difficult to adapt to non-standard or specific SECM measurements. These limitations are especially highlighted in experiments requiring frequent electrode surface refurbishment or customisation.

The aim of this work is to develop, experimentally test, and evaluate an alternative microelectrode manufacturing method that uses stereolithographic (SLA) or digital light processing (DLP) 3D printing and photopolymer resin, and to determine whether the resin-insulated electrode is suitable for electrochemical measurements.

The microelectrode was manufactured using a metal core, which was insulated with photopolymer resin and integrated into a stereolithographic (SLA) and digital light processing (DLP) 3D printed body. This method allows the electrode geometry to be freely changed and adapted to the requirements of the investigation, as well as reducing its cost. The active disc-shaped surface of the scanning electrochemical microelectrode was formed by sanding. The electrochemical properties were evaluated by measurements in $K_3[Fe(CN)_6]$ solution using a standard three-electrode system.

The experimental results showed that the ground microelectrode exhibits a clear, stable and repeatable oxidation and reduction response (a properly shaped Cyclic Voltammetry (CV) plot is obtained), comparable to the electrochemical properties of classical microelectrodes, while unpolished microelectrode did not show a significant electrochemical signal, thus confirming the effectiveness of the photopolymeric resin insulation and the tightness of the shell.

Results show that this method of microelectrode fabrication is promising for electrochemical applications. Due to its fast iteration capability, freedom of shape and lower cost, this method can be a useful alternative to classical glass-shell microelectrodes. The work provides a methodological basis for further research focusing on process optimisation and increasing the reproducibility of electrode fabrication.