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Vibration Analysis of Nanoporous AAO Membrane by Using High-Frequency Excitation Technique in Electrochemical Reactor

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Extended Abstract

This article describes the research and development of nanoporous anodic aluminum oxide (AAO) membrane fabrication technology. There are many studies in the literature that analyse the dependence of the pore geometry of AAO on various parameters such as anodization time, temperature, type of electrolyte, concentration, etc [1-4]. However, control of the geometry of AAO nanopores using high-frequency excitation techniques during the anodization process is in the early stages of research, so no dependence has been established yet. Therefore, this paper presents a high-frequency excitation technique and a novel design of the electrochemical reactor that is designed to control the geometry of nanosized pores.

Vibrations in the electrochemical reactor can be achieved using a piezoelectric ceramic material such as lead zirconate titanate (PZT), which has good electromechanical properties and can be used in the development of various devices [5]. An electrochemical reactor was developed to combine two processes (anodization and high-frequency excitation) in one technology.

The theoretical and experimental results of the vibration analysis confirm that the developed electrochemical reactor can use the high-frequency excitation technique during the two-step anodization process. Using a precise real-time instrument for surface measurement (PRISM) holography system (Hytec, USA) [6], five resonant modes of different frequencies (from 2.2 to 10.7 kHz) have been achieved in the novel reactor. Moreover, AAO membranes were synthesized. The pore diameters were found between 28-96 nm. The results of this study reveal that the innovative electrochemical reactor meets the synthesis criteria and is suitable for the fabrication of nanopores.

The results of this study will greatly contribute to the research and development of better quality nanoporous AAO membranes. Therefore, more research should focus on nanoporous AAO membrane fabrication by using the high-frequency excitation technique to find the dependence of the nanopore geometry at different frequencies.

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