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ELECTROCHEMICAL INVESTIGATION OF COPPER-ZIRCONIUM BASED METALLIC GLASS

By

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Date & Venue

Friday, 19 May 2023

10:00 am to 11:00am

F1 Building - Room 1043

Abstract

This thesis is concerned with the electrochemical investigation of the copper-zirconium based metallic glass $Cu_{51}Zr_{30}Hf_{14}Ag_5$. Studying the corrosion behavior of the novel melt-spun metallic glass ribbons contributes to further research on the possibility of building future bio-implants. The objectives of this thesis are to synthesize the metallic glass ribbons which are free from cytotoxic elements using melt spinning technique, verify their amorphous nature using X-ray diffraction method, study the corrosion behavior using Potentiodynamic polarization and electrochemical impedance spectroscopy in different acidic, neutral and basic solutions, and finally examine the surface morphology of the tested samples using scanning electron microscopy that is coupled with energy dispersive spectroscopy. The results of the experiments done in this thesis show that the addition of Ag and Hf in the novel $Cu_{51}Zr_{30}Hf_{14}Ag_5$ metallic glass generally results in a better corrosion resistance than the previously studied $Cu_{46}Zr_{40}Ti_{8.5}Al_{5.5}$ in the tested solutions, where the novel metallic glass shows a corrosion resistance in the different solutions with the order neutral $>$ alkaline $>$ acidic. The results will contribute to further studies concerned about the potential applications of the novel metallic glass, in addition to its potential use in bio-implants. Furthermore, the study will contribute to introducing more metallic glasses with new compositions tailored for specific potential applications. The Potentiodynamic polarization and electrochemical impedance spectroscopy results were supported by the scanning electron microscopy and the spectral mapping done using the energy dispersive spectroscopy.

Keywords: Metallic glasses, copper, zirconium, corrosion behavior, electrochemical investigation, melt spinning, X-ray diffraction, Potentiodynamic polarization, electrochemical impedance spectroscopy, scanning electron microscopy, energy dispersive spectroscopy, surface morphology, HCl, NaCl, NaOH