Effect of High-pressure Torsion Deformation on Surface Properties and Biocompatibility of ti-50.9 mol. %ni Alloys

Dayangku Noorfazidah Awang Shri[a] and Koichi Tsuchiya[b]

[a]Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 pekan, Pahang, Malaysia

[b]Graduate School of Pure and Applied Sciences, University of Tsukuba, Tsukuba, Ibaraki 305-8577, Japan

and Structural Materials Unit, National Institute for Materials Science, Tsukuba, Ibaraki 305-0047, Japan

ABSTRACT

Ti-50.9 mol. %Ni was subjected to high-pressure torsion (HPT) deformation for different number of rotations (N) of 0.25, 0.5, 1, 5, and 10. The structural changes induced by HPT were analyzed using x-ray diffractometer (XRD). The surfaces of the samples before and after cell culture were characterized using x-ray photoelectron spectroscopy (XPS). The biocompatibility of the samples was evaluated based on a colony formation assay, nickel ion release, and protein adsorption behavior. XRD analysis revealed the occurrence of grain refinement, phase transformation, and amorphization in the TiNi samples by HPT deformation due to high dislocation density. The changes in chemical composition and thickness of the passive film formed on the surface observed in XPS analysis reveals improvement in the stability of the passive film by HPT deformation. The microstructural change due to the deformation was found to influence the biocompatibility behaviors of TiNi. Plating efficiency and protein adsorption were found to be higher when the samples are in stress-induced martensitic or amorphous state. HPT deformation was found to alter the surface behavior of the TiNi, which effectively reduced the Ni ion release and improved its biocompatibility.

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