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Preliminary Study of Material Properties on PU-Mg and PU-Zn for Aneurysm Clip Application

Hardness and Corrosion Behavior of TI-20Cu-20Ni-20Mn-20Zn as High Entropy Alloy and Ti-13Cu-9Ni-5Mn-5Zn for Marine Structure Application

Effect of Heating Temperature and Die Insert Draft Angle on the Flowability of Hot Forged SCM 435 Steel

Effect of Nd_2O_3 and Fe_2O_3 Addition on Gadolinia Doped Ceria (GDC) Solid Electrolyte System for Intermediate Temperature-Solid Oxide Fuel Cell (IT-SOFC) Applications

Synthesis and Characteristic of Nano Silica from Geothermal Sludge: Effect of Surfactant

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PREFACE

Thanks to Allah SWT, five articles could be published in Metalurgi Magazine Volume 37 Number 2 in August 2022.

The first article conducted by Made Subekti Dwijaya et al. on Preliminary Study of Material Properties on PU-Mg and PU-Zn for Aneurysm Clip Application. The second article, Hardness and Corrosion Behavior of Ti-20Cu-20Ni-20Mn-20Zn as High Entropy Alloy and Ti-13Cu-9Ni-5Mn-5Zn for Marine Structure Application, was presented by Muhammad Azhar Ariefkha Dani et al. In the following article, Nofrijon Sofyan et al. discussed Effect of Heating Temperature and Die Insert Draft Angle on the Flowability of Hot Forged SCM 435 Steel. Muhammad Faisal Akbar et al. discussed the fourth article, Effect of Nd_2O_3 and Fe_2O_3 Addition on Gadolinia Doped Ceria (GDC) Solid Electrolyte System for Intermediate Temperature-Solid Oxide Fuel Cell (IT-SOFC) Applications. Aufa Rai Adiatama et al. wrote the fifth article, Synthesis and Characteristic of Nano Silica from Geothermal Sludge: Effect of Surfactant.

Hopefully, the publication of this volume of Metalurgi Magazine will benefit the advancement of research in Indonesia.

EDITORIAL

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UDC (OXDCF) 620.1

Made Subekti Dwijaya, Talitha Asmaria (Research Center for Metallurgy, National Research and Innovation Agency)

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Preliminary Study of Material Properties on PU-Mg and PU-Zn for Aneurysm Clip Application

An aneurysm clip is an implant tool for assisting the neurosurgeon in treating acute hemorrhagic stroke and cerebral aneurysm. This equipment stops the blood flow of a ruptured or enlarged blood vessel or aneurysm. In the development of aneurysm clip production, titanium alloy is the most used material selection. Several researchers reported that this metal leads to artifacts during MR (magnetic resonance) or CT (computed tomography) imaging. Since several pieces of evidence polyurethane could be a good material selection for aneurysm clips, this paper aims to investigate the material properties of the polyurethane foam with an additional combination of magnesium and zinc. This study conducts magnesium and zinc composition variations of 1 wt.%, 2 wt.%, and 3 wt.%, respectively. The materials were tested using a compression test, a FTIR (fourier-transform-infrared), SEM (scanning-electron-microscope), DSC (differential-scanning-calorimetry), and TGA (thermogravimetric-analyzer) to determine the material properties. From all examinations, adding magnesium and zinc to polyurethane foam affected the compressive strength and porosity of the polyurethane foam. Therefore, all test results concluded that adding magnesium with a composition of 3wt.%, which has a compressive strength of 0.84 MPa, is the best mixture. The idea of finding other compositions that are compatible with the polyurethane will significantly increase the possibility of new materials for aneurysm clip construction.

Keywords: Aneurysm clip, compressive strength, magnesium, polyurethane foam, zinc

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Hardness and Corrosion Behavior of Ti-20Cu-20Ni-20Mn-20Zn as High Entropy Alloy and Ti-13Cu-9Ni-5Mn-5Zn for Marine Structure Application

Beta titanium alloys and titanium high entropy alloys are promising candidates for marine structural applications. This study aims to compare Ti-20Cu-20Ni-20Mn-20Zn high entropy alloy and Ti-13Cu-9Ni-5Mn-5Zn beta titanium alloy on microstructure, mechanical properties, and corrosion behavior in a 3.5% NaCl solution. Ti-20Cu-20Ni-20Mn-20Zn and Ti-13Cu-9Ni-5Mn-5Zn were produced by powder metallurgy. In the experimental results, it was observed that Ti-20Cu-20Ni-20Mn-20Zn alloy, as a high entropy alloy, has a low hardness value of 190.658 HV and a high corrosion rate of 1.7992 mm/year. The Ti-13Cu-9Ni-5Mn-5Zn alloy as the beta-titanium alloy has a high hardness value of 430.736 HV and a low corrosion rate of 0.12121 mm/year. The results indicate that Ti-13Cu-9Ni-5Mn-5Zn has better corrosion resistance in 3.5% NaCl solution and hardness than Ti-20Cu-20Ni-20Mn-20Zn high entropy alloy.

Keywords: Beta-titanium, high entropy alloys, powder metallurgy, corrosion, marine structure application

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Effect of Heating Temperature and Die Insert Draft Angle on the Flowability of Hot Forged SCM 435 Steel

The flowability problem of a closed forging process in the heavy equipment industry is still widely found. This problem may affect the quality of the product. To solve this problem, the effect of heating temperature and die insert draft angle on the characteristic of hot forged SCM435 steel used for undercarriage track roller has been examined. In the experiment, the workpieces were hot forged at a heating temperatures of 1150 °C, 1200 °C, 1250 °C, and die to insert draft angles of 3°, 5°, and 7° to form undercarriage track roller products. The mechanical properties of the specimens taken from the workpieces were characterized through hardness and dimensional changes, whereas the microstructure was characterized using an optical microscope. The results showed that increasing the heating temperature and die insert draft angle resulted in good flowability. The best product with the specified diameter of 191.2 mm and height of 53.6 mm was obtained from the heating temperature of 1250 °C at the die insert draft angle of 7°. This characteristic agreed with the specified forging design for the undercarriage track roller.

Keywords: Flowability, hot forging, track roller, undercarriage, underfilling

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Effect of Nd_2O_3 and Fe_2O_3 Addition on Gadolinia Doped Ceria (GDC) Solid Electrolyte System for Intermediate Temperature-Solid Oxide Fuel Cell (IT-SOFC) Applications

GDC (gadolinia doped ceria) is a solid electrolyte contender for intermediate-temperature SOFCs (solid oxide fuel cell). However, more development of this solid electrolyte is required to improve its ionic conductivity. We will investigate the effect of Nd_2O_3 and Fe_2O_3 addition on GDC solid electrolytes to boost ionic conductivity. Solid electrolytes of the composition $Ce_{0.9}Gd_{0.2}M_xO_{1.9}$ (M = Nd, Fe) (x = 0% ; 2.5% ; 5%, and 7.5%) were synthesized using mixed oxide method and formed into pellets with a diameter of 1 cm. The pellets were sintered at 1200℃ and 1400℃ for 4 hours in an Argon environment then the EIS (electrochemical impedance spectroscopy) test was performed at 450-650°C. The results showed that the Nd_2O_3 and Fe_2O_3 added were totally dissolved in the ceria structure and produced single-phase cubic fluorite CeO_2. GDC solid electrolyte with Fe_2O_3 addition produces higher densification than Nd_2O_3 addition, where the value reaches 75% in the GDC sintered at 1400℃. However, the addition of Nd_2O_3 further increased the value of ionic conductivity and decreased the activation energy of the GDC solid electrolyte compared to the addition of Fe_2O_3. The highest ionic conductivity and the lowest activation energy were obtained in the GDC with 2.5% Nd_2O_3 in 650℃ operating temperature, with the values achieved were 1.2 mS/cm and 0.41 eV, respectively. Therefore, it can be concluded that Nd_2O_3 addition is more effective to improve the performance of solid electrolyte GDC.

Keywords: SOFC (solid-oxide fuel cell), solid electrolyte, GDC (gadolinia doped ceria), ionic conductivity

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Synthesis and Characteristic of Nano Siilica from Geothermal Sludge: Effect of Surfactant

In the synthesis of nanoparticles, the phenomenon of agglomeration is an undesirable condition because the particles formed can be larger. The use of surfactants can prevent the occurrence of this phenomenon. In this study, the use of surfactants was studied in the synthesis of nano silica from geothermal sludge. The method applied in the synthesis of nano silica is the sol-gel method. A 1 M NaOH (sodium hydroxide) solution was used to prepare of the precursor solution, while the SiO_2 gel formation was carried out at a pH of 5 using a 1.5 M HCl (hydrochloric acid) solution. The surfactants used were ABS (alkyl benzene sulfonate), CTAB (cetyltrimethylammonium bromide), SDS (sodium dodecyl sulfate), and PVP (polyvinylpyrrolidone). The surfactant added to the precursor solution was at the CMC (critical micelle concentration), where the CMC value for each surfactant was 0.15; 0.05; 0.50; and 1.00 wt% for ABS, CTAB, SDS, and PVP, respectively. As a comparison, nano silica synthesis was also carried out without adding of surfactants. The experimental results showed that the synthesis of nano silica without surfactant produced a product with a purity of 98.03%. Based on PSA (particle size analyzer) testing, the average particle size was 4.82 μm. Although the purity was already high, the resulting product experiences agglomeration and surfactants were needed to minimize the occurrence of agglomeration in the product. The surfactant that gives the best product quality is PVP, whose average particle size is 66% smaller than the product without surfactant. However, the effect produced with PVP has a low purity, which is 56.67%. This condition occurs because NaCl was trapped in the surfactant template. The presence of this surfactant template causes the washing process more difficult because the templates become an obstacle for water to diffuse into the particles and dissolve the impurities.

Keywords: Agglomeration, nano silica, geothermal sludge, surfactant