

Sintesis dan karakterisasi paduan logam berpori mg ca zn hasil metalurgi serbuk dengan tih₂ sebagai foaming agent = Synthesis and characterization mg ca zn metal alloy foam as powder metallurgy product with tih₂ as foaming agent

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Abstrak

ABSTRAK

Kebutuhan biomaterial yang semakin tinggi mendorong manusia untuk menciptakan sebuah rekayasa material, sehingga dikembangkanlah material berpori Mg-Ca-Zn dengan TiH₂ sebagai foaming agent. Pembuatan material berpori Mg-Ca-Zn dengan TiH₂ sebagai foaming agent ini menggunakan proses metalurgi serbuk dengan TiH₂ yang tanpa diberi perlakuan panas (TiH₂ untreated) dan diberi perlakuan panas (TiH₂ pre-treated) pada temperatur 450°C selama 2 jam. Pada penelitian ini dilakukan variasi temperatur sinter 500°C, 550°C dan 600°C serta variasi komposisi foaming agent TiH₂ un-treated dan TiH₂ pre-treated sebesar 0,5%; 1,5% dan 3% untuk mengetahui karakteristik material yang meliputi temperatur dekomposisi TiH₂, porositas logam berpori, struktur mikro, fasa, kekuatan tekan serta laju korosi.

Hasil menunjukkan bahwa foaming agent TiH₂ pre-treated berdekomposisi melepaskan hidrogen pada temperatur 520°C serta menghasilkan pori yang lebih homogen dan stabil karena adanya lapisan oksida yang terbentuk pada partikel TiH₂ pre-treated. Fasa yang terbentuk pada paduan logam Mg-Ca-Zn-TiH₂ un-treated yaitu Mg, Ca₂Mg₅Zn₁₃, Ca₂Mg₆Zn₃, Mg₂Ca dan TiH_x, sedangkan pada paduan Mg-Ca-Zn-TiH₂ pre-treated yaitu Ca₂Mg₅Zn₁₃, Ca₂Mg₆Zn₃, Mg₂Ca dan TiH_x, Ti₃O, Ti₂O dan TiH₂. Peningkatan temperatur sinter dan penambahan komposisi foaming agent pada logam berpori Mg-Ca-Zn dengan TiH₂ un-treated dari 500 ke 550°C mengakibatkan nilai porositas dan laju korosi meningkat, namun nilai kuat tekan menurun, dan pada temperatur sinter 600°C mengakibatkan porositas dan laju korosi menurun tetapi kuat tekan meningkat.

Peningkatan temperatur sinter dan penambahan komposisi foaming agent pada logam berpori Mg-Ca-Zn dengan TiH₂ pre-treated cenderung mengalami peningkatan porositas dan laju korosi, namun menurunkan nilai kuat tekan. Dalam studi ini, hasil yang paling optimal yaitu Paduan Mg-1Ca-3Zn dengan penambahan 3%berat TiH₂ pada temperatur sinter 600°C, dengan porositas sebesar 19,1% serta rata-rata ukuran pori 5-7 μm, kuat tekan 178,85 N/mm² dan laju korosi 2,41 mmpy.

<i>ABSTRACT</i>

The increasing demand of biomaterial has been encouraging researchers to engineer a biodegradable material, which lead to development of porous Mg-Ca-Zn with the addition of TiH₂ as a foaming agent. The synthesis of porous Mg-Ca-Zn with the addition of TiH₂ as a foaming agent was performed by powder metallurgy method. The addition of TiH₂ was categorized by those that pre-treated with the heat treatment at 450 °C for two hours and those that untreated. In this study, the sintering process was performed at different temperatures i.e. 500°C, 550°C and 600°C. The amount of TiH₂ addition was varied at 0,5%; 1,5% and 3% in weight to investigate the TiH₂ decomposition temperature, porosity, microstructures, phase

formation, mechanical properties and the corrosion rate.

The characterization results of samples with the addition of pre-treated TiH_2 showed that foaming agent material TiH_2 was decomposed at 520°C and releasing hydrogen to develop stable and homogenous-distributed pores, due to the formation of oxide layers. The X-ray diffraction (XRD) patterns revealed that the phase formation in samples with the addition of untreated TiH_2 were Mg, $\text{Ca}_2\text{Mg}_5\text{Zn}_{13}$, $\text{Ca}_2\text{Mg}_6\text{Zn}_3$, Mg_2Ca and TiH_x , while in samples with the addition of pre-treated TiH_2 were $\text{Ca}_2\text{Mg}_5\text{Zn}_{13}$, $\text{Ca}_2\text{Mg}_6\text{Zn}_3$, Mg_2Ca dan TiH_x , Ti_3O , Ti_2O dan TiH_2 . The increasing of sintering temperatures and foaming agent material content of porous Mg-Ca-Zn alloy with addition of untreated TiH_2 affected the increasing porosity and corrosion rate, despite the lower value of compressive strength.

While the sintering temperature of 600°C gave the decreasing of porosity and corrosion rate but increasing the compressive strength. The increasing of sintering temperature and foaming agent material content of porous Mg-Ca-Zn alloy with addition of pretreated TiH_2 resulted to increasing of porosity and corrosion rate, but lowering the compressive strength. In this study, the optimum sample was found to be Mg-Ca-3Zn with the addition of 3% TiH_2 synthesized at 600°C , owing porosity of 19,1% with the pore sizes of 5-7 μm , compressive strength of 178,85 N/mm^2 corrosion rate of 2,41 mmpy.