OPTIMALISASI PROSES DEPOSISI ELEKTROFORESIS (EPD) UNTUK PELAPISAN GAMMA-ALUMINA HASIL DAUR ULANG PADA TITANIUM UNTUK APLIKASI IMPLAN GIGI

TESIS

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar magister sains

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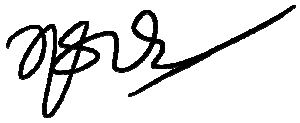
disetujui dan disahkan oleh pembimbing

Pembimbing I



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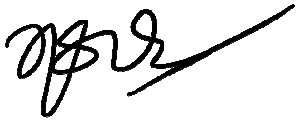

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ABSTRAK

Pelapisan gamma alumina (γ-Al_2O_3) dari hasil daur ulang telah berhasil dilakukan pada Cp- Ti menggunakan metode EPD. Penelitian ini bertujuan untuk untuk menganalisis pengaruh parameter EPD terhadap hasil lapisan γ-Al_2O_3 daur ulang. γ-Al_2O_3 disintesis dari kaleng dengan menggunakan metode sol-gel. Pelapisan γ-Al_2O_3 pada Cp-Ti dilakukan dengan pendekatan desain eksperimen (DoE) Taguchi untuk mengoptimalkan parameter EPD seperti pH dan konsentrasi, serta tegangan. Karaktersasi γ-Al_2O_3 dilakukan menggunakan XRD, FTIR, Particel Size Anlyzer (PSA) dan juga BET, serta potential zeta untuk suspensi γ-Al_2O_3. Lebih lanjut pelapisan γ-Al_2O_3 dikarakterisasi menggunakan 3D OM, XRD dan SEM-EDS. Pengujian korosi dilakukan dengan menggunakan simulasi cairan tubuh SBF. Alumina hasil daur ulang menunjukkan difratogram XRD pada puncak 2θ 32,06°, 37,84°, 45,98°, dan 67,17° yang menunjukkan fasa γ. Analisa FT-IR juga muncul pada serapan 513 cm^{-1} untuk vibrasi bending Al-O oktahedral dan 820 cm^{-1} untuk vibrasi bending Al-O tetrahedral. γ- Al_2O_3 memiliki distribusi ukuran partikel 314 nm, dengan ukuran pori 2,45 nm. Hasil menunjukkan parameter EPD pada pH 2, konsentrasi 5g/L dan tegangan 30V menghasilkan *deposition yield* dan homogenitas yang tinggi. Berdasarkan nilai delta rasio S/N sebsesar 16,66 dan 3,97, pH merupakan parameter yang paling berpengarauh pada hasil lapisan termasuk *deposition yield* dan homogenitas. Urutan parameter yang mempengaruhi hasil lapisan adalah pH>konsentrasi>tegangan. pH 2 menunjukkan potential zeta sebesar +9,56 mV dengan mobilitas 0,2697 cm^2/V.s. Lapisan γ-Al_2O_3 menghasilkan kekasaran dalam rentang 1,58-2,38 µm. Parameter optimum menghasilkan lapisan dengan kekasaran 1,91 µm yang termasuk kategori kekasaran implan yang ideal. Lapisan alumina juga mempertahankan fasa nya dalam bentuk γ-Al_2O_3. Potensi korosi pada Cp-Ti yang dilapisi γ-Al_2O_3 menunjukkan nilai E_{corr} 232,169 mV, lebih tinggi dibandingkan dengan Cp-Ti tanpa lapisan (E_{corr} -845,712 mV). Selain itu, Cp-Ti terlapisi γ-Al_2O_3 memiliki nilai I_{corr} sebesar $9{,}10\times10^{-7}$ A/cm² dengan resistansi polarisasi (Rp) sebesar $3{,}82\times10^{4}$ Ω·cm². Hasil ini menunjukkan bahwa pelapisan γ-Al_2O_3 daur ulang pada Cp-Ti secara signifikan meningkatkan ketahanan korosi dibandingkan Cp-Ti tanpa lapisan.

Kata kunci: Cp-Ti, gamma alumina, *electrophoretic deposition*, implan

ABSTRACT

Gamma alumina (γ-Al2O3) coating from recycled sources has been successfully applied to Cp-Ti using the EPD method. This study aims to analyse the effect of EPD parameters on the results of recycled γ-Al2O3 coating. γ-Al2O3 was synthesised from cans using the sol-gel method. The γ-Al2O3 coating on Cp-Ti was conducted using Taguchi's design of experiments (DoE) approach to optimise EPD parameters such as pH and concentration, as well as voltage. The γ-Al2O3 characterisation was carried out using XRD, FTIR, Particel Size Anlyzer (PSA) as well as BET, and zeta potential for γ-Al2O3 suspension. The γ-Al2O3 coatings were further characterised using 3D OM, XRD and SEM-EDS. Corrosion testing was conducted using simulated SBF body fluids. The recycled alumina showed XRD diffractograms at 2θ peaks of 32.06°, 37.84°, 45.98°, and 67.17° indicating γ phase. FT-IR analysis also showed absorption at 513 cm-1 for octahedral Al-O bending vibrations and 820 cm-1 for tetrahedral Al-O bending vibrations. γ-Al2O3 has a particle size distribution of 314 nm, with a pore size of 2.45 nm. The results showed EPD parameters at pH 2, concentration 5g/L and voltage 30V resulted in high deposition yield and homogeneity. Based on the S/N ratio delta values of 16.66 and 3.97, pH is the most influential parameter on the coating results including deposition yield and homogeneity. The ranking of parameters that affect the coating yield is pH>concentration>voltage. pH 2 shows a zeta potential of +9.56 mV with a mobility of 0.2697 cm2/V.s. The γ-Al2O3 coating resulted in roughness in the range of 1.58-2.38 µm. The optimum parameters produced a coating with a roughness of 1.91 µm which is in the ideal implant roughness range. The alumina coating also retains its phase in its γ-Al2O3 form. The corrosion potential of γ-Al2O3 coated Cp-Ti showed an Ecorr value of 232.169 mV, higher than that of uncoated Cp-Ti (Ecorr -845.712 mV). In addition, Cp-Ti coated with γ-Al2O3 has an Icorr value of 9.10×10^{-7} A/cm² with a polarisation resistance (Rp) of 3.82×10^{4} Ω-cm². These results show that recycled γ-Al2O3 coating on Cp-Ti significantly improves the corrosion resistance compared to uncoated Cp-Ti..

Keyword: Cp-Ti, gamma alumina, electrophoretic deposition, implant

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DAFTAR TABEL

DAFTAR ISI

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