



SYNTHESIS OF SILICA PARTICLES REINFORCED HYDROXYAPATITE COMPOSITE AT VARIOUS CALCINATION TEMPERATURES

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ABSTRACT

In this research, silica particles reinforced hydroxyapatite composite (HA/SiO₂) using fumed silica as the source of silica particles has been synthesized. This study aims to study the effect of adding silica particles and calcination temperature on the character of HA/SiO₂ composites which include crystallinity, functional groups, morphology, Ca/P ratio and compressive strength.

The synthesis with the precipitation method, was started with the addition of fumed silica particles into a solution of Ca(NO₃)₂·4H₂O at a pH of 1.0 and continued by adding a solution of NaH₂PO₄·H₂O and adjusting the pH with the addition of 25% NH₄OH so that it was more than 9.0. The precipitate was dried in an oven at 40 °C for 48 hours and mashed with a mortar, and calcined in a furnace at various temperatures, namely 600, 700, 800, 900, and 1000 °C for 2 hours. The resulted powder was characterized using XRD, FTIR, SEM-EDX, and compressive strength test.

The results show that other crystalline phases were formed namely α-TCP and β-TCP on HA calcined at 900, 1000 °C and HA/SiO₂ composites calcined at 1000 °C. The HA crystal size was 12.3–43.9 nm and the HA/SiO₂ composite was 8.87–20.0 nm. In the FTIR spectra, the PO₄³⁻ and OH⁻ functional groups indicated the presence of HA components. The morphology of HA and HA/SiO₂ composites shows the formation of agglomerates. The compressive strength value of the HA/SiO₂TK composites was 4.78 ± 0.0100 MPa, the HATK was 1.32 ± 0.240 MPa, but the compressive strength value decreased with increasing the calcination temperature.

Keywords: HA/SiO₂, fumed silica, hydroxyapatite, calcination.



SINTESIS KOMPOSIT HIDROKSIAPATIT TERKUATKAN PARTIKEL SILIKA PADA VARIASI TEMPERATUR KALSINASI

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INTISARI

Dalam penelitian ini sintesis komposit hidroksiapatit terkuatkan partikel silika (HA/SiO₂) menggunakan *fumed silica* sebagai sumber silika. Penelitian ini bertujuan untuk mempelajari pengaruh penambahan partikel silika dan temperatur kalsinasi pada karakter komposit HA/SiO₂ yang meliputi kekristalan berupa parameter kisi dan ukuran kristalin, gugus fungsional, morfologi, perbandingan Ca/P serta kuat tekan.

Sintesis HA/SiO₂ diawali dengan penambahan partikel *fumed silica* pada larutan Ca(NO₃)₂·4H₂O pada pH 1,0 dan dilanjutkan penambahan larutan NaH₂PO₄·H₂O serta diatur pHnya dengan penambahan NH₄OH 25% sehingga lebih dari 9,0. Endapan dikeringkan dalam oven pada 40 °C selama 48 jam kemudian dihaluskan dengan mortar, serta dikalsinasi dalam *furnace* pada variasi temperatur yaitu 600, 700, 800, 900 dan 1000 °C selama 2 jam. Serbuk yang dihasilkan dikarakterisasi dengan XRD, spektrofotometer FTIR, SEM-EDX dan uji kuat tekan.

Hasil penelitian menunjukkan bahwa selain produk HA terbentuk fasa kristalin lain berupa α-TCP dan β-TCP pada HA kalsinasi 900, 1000 °C dan komposit HA/SiO₂1000. Penambahan partikel silika menurunkan ukuran kristalin HA dari 12,3–43,9 nm menjadi 8,87–20,0 nm. Pada spektra FTIR, keberadaan gugus fungsi PO₄³⁻ dan OH⁻ mengindikasikan adanya komponen HA. Morfologi HA dan komposit HA/SiO₂ menunjukkan terbentuknya aglomerat. Penambahan partikel silika meningkatkan nilai kuat tekan dari 1,32±0,240 MPa menjadi 4,78±0,0100 MPa, namun nilai kuat tekan menurun seiring dengan meningkatnya temperatur kalsinasi.

Kata Kunci: HA/SiO₂, *fumed silica*, hidroksiapatit, kalsinasi.