World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:07, 2018

Preparation of Magnetic Hydroxyapatite Composite by Wet Chemical Process for Phycobiliproteins Adsorption

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Abstract : Hydroxyapatite (Ca10(PO4)6(OH)2, HAp) can be applied to the fabrication of bone replacement materials, the composite of dental filling, and the adsorption of biomolecules and dyes. The integration of HAp and magnetic materials would offer several advantages for bio-separation process because the magnetic adsorbents is capable of recovered by applied magnetic field. C-phycocyanin (C-PC) and Allophycocyanin (APC), isolated from Spirulina platensis, can be used in fluorescent labeling probes, health care foods and clinical diagnostic reagents. Although the purification of C-PC and APC are reported by HAp adsorption, the adsorption of C-PC and APC by magnetic HAp composites was not reported yet. Therefore, the fabrication of HAp with magnetic silica nanoparticles for proteins adsorption was investigated in this work. First, the magnetic silica particles were prepared by covering silica layer on Fe3O4 nanoparticles with a reverse micelle method. Then, the Fe3O4@SiO2 nanoparticles were mixed with calcium carbonate to obtain magnetic silica/calcium carbonate composites (Fe3O4@SiO2/CaCO3). The Fe3O4@SiO2/CaCO3 was further reacted with K2HPO4 for preparing the magnetic silica/hydroxyapatite composites (Fe3O4@SiO2/HAp). The adsorption experiments indicated that the adsorption capacity of Fe3O4@SiO2/HAp toward C-PC and APC were highest at pH 6. The adsorption of C-PC and APC by Fe3O4@SiO2/HAp could be correlated by the pseudo-second-order model, indicating chemical adsorption dominating the adsorption process. Furthermore, the adsorption data showed that the adsorption of Fe3O4@SiO2/HAp toward C-PC and APC followed the Langmuir isotherm. The isoelectric points of C-PC and APC were around 5.0. Additionally, the zeta potential data showed the Fe3O4@SiO2/HAp composite was negative charged at pH 6. Accordingly, the adsorption mechanism of Fe3O4@SiO2/HAp toward C-PC and APC should be governed by hydrogen bonding rather than electrostatic interaction. On the other hand, as compared to C-PC, the Fe3O4@SiO2/HAp shows higher adsorption affinity toward APC. Although the Fe3O4@SiO2/HAp cannot recover C-PC and APC from Spirulina platensis homogenate, the Fe3O4@SiO2/HAp can be applied to separate C-PC and APC.

Keywords : hydroxyapatite, magnetic, C-phycocyanin, allophycocyanin
Conference Title : ICCMC 2018 : International Conference on Ceramic Materials and Components
Conference Location : Rome, Italy
Conference Dates : July 23-24, 2018