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Song Chen, Tianlong Wang, Yunhong Yao, Aili Wei



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Facile synthesis of novel fibrous silica@apatite@Au composites with superior photo-catalytic activity

Song Chen^{*}, Tianlong Wang, Yunhong Yao, and Aili Wei^{*}

College of Materials Science and Engineering, Taiyuan University of Technology, Taiyuan 030024, China

Corresponding author: Prof. Song Chen and Prof. Aili Wei

E-mail: chensong2009@126.com; weailidd@126.com

Abstract

Novel fibrous silica@apatite@Au composites with superior photo-catalytic activity were facilely synthesized through combination of electrospinning technique, bio-mineralization, and in situ immobilization. Silica nanofibers with the diameter of 486 ± 60 nm were synthesized through electrospinning of the sol-gel mixture of gelatin, tetraethoxysilane, acetic acid, water, and calcium chloride followed by sintering process. After bio-mineralization in the Kokubo's simulated body fluid, silica nanofibers supported in situ deposition of fibrous apatite nanosheet flowers to produce fibrous silica@apatite composites. SEM observations showed that the silica@apatite composites had the fibrous feature with the diameter of 2498 ± 608 nm and their surface was very rough and constructed by numerous apatite nanosheets with the thickness around 10 nm. XRD patterns showed that the fibrous silica@apatite composites presented the characteristic diffraction peaks at 26° and 32° assigned to apatite components. FT-IR spectra revealed that silica@apatite composites contained both Si-O-Si bonds and P-O-P groups. After immersion in the suspension of Au nanoparticles, the silica@apatite composites supported the in situ immobilization of Au nanoparticles to produce silica@apatite@Au composites. When incubated in the aqueous mixture of 4-nitrophenol and NaHB_4 , the fibrous silica@apatite@Au composites presented a superior photo-catalytic activity and rapidly catalyzed the reduction of 4-nitrophenol to 4-aminophenol.

Keywords: Apatite nanosheets; Electrospinning; Silica nanofibers; Bio-mineralization; Au nanoparticles; Photo-catalytic activity

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