A Review on Nanofiber Scaffolds by Focusing on Constituents and Procedures

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Abstract
Nanofiber scaffolds have been utilized in the controlled delivering of the drug, cell, and gene into the body organs for an effective treatment of various diseases. The natural and synthetic polymers and their blends as well as the bioceramics could be considered as the constituents of nano-scaffolds. One of the advantges of tissue engineering is the three-dimensional culturing, which could be found in the original organs and tissues. Therefore, the cells and other components could not be properly directed in the two-dimentional environments. That is why, the novel fabrication methods have been introduced. Various fabrication methods like electrospinning, drawing, template synthesis, fiber-mesh, self-assembling, fiber-bonding and solid freeform fabrication techniques are applied for fabrication of nanofiber scaffolds. In the current work, in addition to review on the characteristicts and constituents of scaffolds, their fabrication technologies were focused. The unique properties of nanofiber-based structures include the high loading efficiency, superior mechanical performance, packaging for an ample range of drugs, controlled release behavior and excellent stability in the delivery of plasmid DNA, large protein drugs, genetic materials and autologous stem-cell to the target site.

Keywords: Nanofiber Scaffold, Electrospinning, Drawing, Giber Mesh, Self-Assembly.

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Comparison Between Gas Sweetening Processes & Economical Feasibility Study of Sour Flare Gas Sweetening by Catalytic Conversion of H_2S to Methyl Mercaptan

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Abstract
Abstract: Iran, one of the largest greenhouse gas producers in the world, burns hundreds of thousands of tons of sour gases annually, through the flare systems. Sweetening of sour gases, using amin absorption process, with combination of Claus process is the most common process, with a huge amount of sulfur, as by product. In this paper, a feasibility study has been done for "catalytic conversion of H_2S to methyl mercaptan" as a novel process for sweetening of sour gases. This investigation shows that the use of this method has a great benefit in comparison with the H_2S -to-sulfur conversion processes. The study examined one of Iranian petrochemical companies that burns more than 80,000 tons of gas per year. The results show that by the catalytic conversion of H_2S to methyl mercaptan in this petrochemical complex, while producing one of the country's most needed strategic materials, the gross profit of the project is more than 25 million US$ annually. The benefit of this method is 4 times of the H_2S to Sulfur method and the total cost will return in less than two years.

Keywords: Methyl Mercaptan, H_2S, Sour Gas, Sweetening.

Synthesis of High Biocompatible Mesoporous Silica Nanocarriers with Regular and Uniform Pore Distribution for Doxorubicin Drug Delivery

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Abstract

In this study, biocompatible mesoporous silica nanocarriers were synthesized with the regular and uniform pore distribution from natural sources of rice and wheat husk under sol-gel process for sustainable drug delivery to breast cancer cells. The physicochemical properties of nanocarriers were investigated by XRD, FT-IR, SEM and BET analyzes. Nanocarriers obtained from rice and wheat husk had a specific surface area of 741.44 and 630.52 m^2/g, respectively, with regular and uniform pore distribution with a size of 2.58 and 3.63 nm. Doxorubicin was loaded as a model drug into the nanocarriers and drug release was evaluated at pH 7.4 and 5.4. The results showed that the drug release rate doubled under acidic conditions which simulating the tumor environment. By examining the cytotoxicity of nanocarriers on the HFF-2 and MCF-7 cell lines, it was found that the nanocarriers have high biocompatibility and prevent the growth and cause to cancerous cells death.

Keywords: Mesoporous Silica Nanoparticles, Regular Pore Distribution, Rice Husk, Wheat Husk, Drug Delivery, Breast Cancer.

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Improvement of Photocatalytic Activity of ZnO Nanoparticles by Mn Doping in BD71 Degradation

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Abstract

In the present paper, ZnO and manganese doped ZnO (Mn-ZnO) nanoparticles were synthesized via sol-gel method. The prepared samples were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX). XRD results exhibited that Mn was successfully doped in the ZnO structure. SEM images confirmed that the particle size of ZnO and Mn-ZnO samples were in the nanometer ranges. Photocatalytic activity of ZnO and Mn-ZnO nanoparticles on the degradation of direct blue 71 (DB71) under UV light irradiation was investigated. DB71 degradation reached to 82% and 97% after 90 min irradiation using ZnO and Mn-ZnO photocatalysts, respectively. A mechanism for the behavior of the Mn-ZnO nanoparticles and the role of Mn in the enhancement of ZnO photocatalytic activity was proposed. The kinetic studies revealed that the photocatalytic degradation kinetics of DB71 would follow a pseudo first order reaction. Mn-ZnO nanophotocatalyst exhibited appropriate stability for several reuses.

Keywords: Zinc Oxide, Mn-ZnO Nanoparticles, Photocatalytic Degradation, DB71.

Synthesis and Characterization of UiO-66 Metal Organic Framework Nanostructure

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Abstract

The purpose of the present work is to synthesize and characterize of the nanostructure of the metal organic framework of UiO-66. Synthesis was performed using zirconium tetrachloride, terephthalic acid, N, N-dimethylformamide and chloroform. The synthesized UiO-66 was characterized by XRD, FT-IR, FESEM and BET analysis. In the XRD curve, characteristic peaks were observed at 2θ angles of 7.4°, 8.5° and 25.8°, which confirm the successful synthesis of UiO-66 crystalline nanoparticles. The FT-IR analysis showed the formation of functional groups of OH at 3428 cm^{-1}, O-C-O asymmetric stretch at 1566 cm^{-1}, O-C-O symmetric stretch at 1399 cm^{-1} and Zr-O bond stretching vibration of the framework at 1082 cm^{-1} in UiO-66 structure. The results of FESEM analysis showed the formation of single cubic crystals of UiO-66 with octagonal morphology and nanoparticles were observed in the range of 30 to 60 nm. Nitrogen adsorption-desorption curve of UiO-66 was from type I and the specific surface area of BET, total pore volume and average pore diameter were 1130.9 m^2/g, 1.1429 cm^3/g and 4.425 nm, respectively, which confirm the large surface area and high pore volume of UiO-66.

Keywords: Crystalline Nanoparticles, Metal Organic Framework, Octagonal Morphology, UiO-66.

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Predicting Ice Formation on the Surfaces Exposed to the Air Containing Supercooled Droplets Using Smooth Particle Hydrodynamics Method

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Abstract

Weakly Compressible Smoothed Particle Hydrodynamics (WCSPH) was applied to simulate the three dimensional, three-phase phenomenon of ice formation on a solid surface exposed to the humid airflow. It was assumed that air contains supercooled droplets of that, upon collision with a solid surface, some of them undergo a phase change and turn to ice. To describe this phenomenon, fluid hydrodynamic equations along with energy balance equations were considered and solved. The validity of the method was confirmed because the collection efficiency obtained from this method for flow on spheres was in good agreement with the literature. Then this method was used to predict this process in different conditions. The effect of Stokes dimensionless number on local collection efficiency and the effect of surface heat flux on the local and average ice formation efficiency were investigated. It was observed that the collection efficiency is higher in the center of the body and increases with increasing Stokes number. Consequently, the average efficiency of ice formation decreases with increasing flux. Also, the overall efficiency of ice formation in the center of the body is higher and less at the sides.

Keywords: Smoothed Particle Hydrodynamics (SPH), Phase Change, Collection Efficiency, Heat Flux.