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Assessment of the production of hydroxyl radical using nano zero-valent iron embedded in a mesoporous silica matrix

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Zero-Valent Iron (Fe0) has been shown to detoxify water by creating hydroxyl radicals through Fenton-like reactions combined with hydrogen peroxide (H_2O_2) to get rid of organic contaminants. Nano-sized zero-valent iron (n/ZVI) in combination with oxidants and UV radiation, has been reported can increase the Fenton reaction rate and make water detoxification more effective. In this work, the production of reactive oxygen species, particularly hydroxyl radicals, was assessed for the heterogeneous photo-assisted Fenton-like reaction using nZVI embedded in a mesoporous silica matrix, hydrogen peroxide, and UV-A radiation. The experiments consisted of preparing a 10 μM solution of N, N-dimethyl-p-nitroaniline (pNDA, used as HO• radical probe) in 100 mL of water and adding the silica-embedded nZVI at three different loads (please include loads of Zvi in the SBA-15) with or without H_2O_2, and/or UV-A radiation (λmax=365 nm). The absorbance of the pNDA was measured and compared to that of clear, deionized water. The trials consisted of using immobilized nZVI alone, immobilized nZVI/H_20_2, and immobilized nZVI/H_20_2/UV. From the experimental results, we have seen that the best conditions for hydroxyl radicals production measured as pNDA bleaching are by the combination of immobilized nZVI/H_2O_2/UV despite nZVI, UV-A radiation and hydrogen peroxide alone were capable of bleaching pNDA to a certain extent. The use of the H_2O_2/UV system reached a plateau in hydroxyl radical production after 20 min of reaction. Two kinetic models are proposed to fit experimental data for the different reaction conditions tested and the obtained results were capable of fitting experimental data fairly good meaning that the proposed reaction mechanisms may occur within the reaction mixture to some extent. This novel material found was with interesting capabilities to produce reactive oxygen species, particularly hydroxyl radicals, under photo assisted conditions and high potential for further photocatalytic applications in water treatment.

Speaker Biography

Steven Huezo Pineda is an assistant researcher working with Erick Bandala at Desert Research Institute in Las Vegas, Nevada. He is an undergrad majoring in Biochemistry at the University of Nevada, Las Vegas. He has been working at DRI (Desert Research Institute) since January, focusing on Zero-Valent Iron and using it to clean pollutants of water. Steven Huezo will plan to continue his work next year, working with the Department of Energy to clean chlorine from groundwater.

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