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## Macroporous alginate substrate-bound growth of $Fe^0$ nanoparticles: Characterization and reactivity for nitrate removal from aqueous solutions

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Zero-valent iron nanoparticles (nZVI, $Fe^0$ NPs) are capable of effectively degrading a broad range of environmental contaminants and have been extensively studied as a tool for groundwater remediation. However, $Fe^0$ NPs agglomerate rapidly; this process can significantly decrease their effective surface area and thus significantly reduce their reactivity. One way to overcome this problem is to develop chemically-stable composite materials that can reduce the agglomeration of $Fe^0$ NPs. Herein, to solve these problems, macroporous alginate substrate-supported $Fe^0$ NPs ($Fe^0$ NPs/MAS) were firstly synthesized by a two-part $Fe^0$ NP-immobilization approach: 1) The fabrication of a macroporous alginate substrate (MAS) that provided a large surface area capable of sustaining a high load of stable and well-dispersed $Fe^0$ NPs (26.06 wt.%); and 2) a facile chemical reductive growth procedure to generate $Fe^0$ NPs (ca. 50-100 nm) that are covalently anchored to the surface of the MAS. Batch experiments were further carried out to elucidate the efficiency of the $Fe^0$ NPs/MAS towards nitrate removal from aqueous solution. Compositional and structural characterizations showed that the reductively grown hemispherical shaped-$Fe^0$ NPs were covalently immobilized onto MAS mainly though Fe–O–C connections, which improved not only $Fe^0$ NPs stability but also their reactivity. The $Fe^0$ NPs/MAS removed >96.5% of nitrates from an aqueous solution within 30 minutes, whereas unsupported $Fe^0$ NPs that removed only 44.7% of nitrates over a longer period of time. These results demonstrate that the enhanced efficiency of $Fe^0$ NPs/MAS is mainly due to agglomeration-prevention effect. On the basis of our experimental results, immobilization of $Fe^0$ NPs through the alginate substrate-bound growth was expected to help develop practical applications for $Fe^0$ NPs in environmental remediation, such as reactive media in permeable reactive barriers (PRBs) or an in-situ subsurface reagent.

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## Combining non-thermal plasma with heterogeneous catalysis in indoor air treatment

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Non thermal plasmas offer a unique way to initiate chemical reactions in the gas phase which have potential for practical utilization in environmental applications. Since plasma-chemical processes are rather nonselective, combination with catalysis can provide improved $CO_2$ selectivity and eliminates undesirable byproducts during VOCs removal. Catalyst activation by plasma is different from that in case of conventional heating, and therefore the knowledge of plasma-catalyst interaction represents a key issue both from the fundamental point of view, for the understanding of reaction mechanisms involved in the plasma-catalytic process, and obviously, from the point of view of applications. In an industrial environment, the characteristics of waste gases can vary during time due to changes in the plasma catalytic process. Therefore, it is important to know how these changes influence the removal of toluene. The key parameters such as the humidly of the air, the temperature, the gas flow rate, energy efficiency and catalysts position will be studied to provide guidelines for engineers.

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