CYCLE DE CONFÉRENCES DE CHIMIE

Avec le concours de : Université Clermont Auvergne
INP Clermont Auvergne

Jeudi 20 juin à 16 h

Amphi Rémi (site des Cézeaux)

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Removal of nitrate from water by chemical reduction

Water pollution by nitrate derives from a wide range of pathways, such as the excessive use of fertilizers in intensive agriculture, leaking of septic tanks and waste disposal in breeding farms. The EU regulation sets maximum concentrations for nitrate, nitrite and ammonium in drinking due to human health risk. Catalytic chemical reduction with hydrogen can convert nitrate into harmless gaseous nitrogen, however partial reduction to intermediate nitrite and over-hydrogenation to ammonium result in treated water not suitable for human consumption. Therefore, control of the activity and selectivity is crucial for the application of nitrate chemical reduction. The control of selectivity depends on several factors including the type of catalyst, the operating conditions and the type of reactor used. The lecture revises the work done at Chemical Engineering Department in UAM on the topic. A multiscale approach has been followed starting with the control of the size of the metal nanoparticles used as active phase in the catalysts. The engineering of the nanoparticles includes shielding of the active sites responsible for ammonium generation, thus achieving complete selectivity to nitrogen in the reduction of nitrite. The role of the support is extensively analyzed, with carbon materials showing very interesting opportunities due to tuneable surface chemistry and porosity, and also due to electric conductivity facilitating redox reaction. Operating conditions, particularly pH and hydrogen availability influence activity and selectivity, with some cross-effect of the salinity in the case of real natural waters. Finally, the influence of the type of reactor is discussed, with a novel approach based on membrane reactors where strict control of hydrogen transfer is achieved, thus avoiding over-hydrogenation to ammonium. The development of novel catalytic membrane contactor reactors is described, together with optimization of configuration and operating conditions that make possible to achieve high nitrate conversion with negligible ammonium generation.

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