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Design of catalytic carbon nanotube-based reactor for water denitration – The impact of active metal confinement. Applied Catalysis B: Environmental, 207-225, 2018. IF 11,698

Scientific paper

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The catalytic reduction of nitrate to N2 represents the efficient water remediation technique in terms of the achieved nitrate depletion, but still with a main drawback – the production of ammonia as the undesired product. Therefore, efforts are undertaken to solve the problem, in terms of both reactor and catalyst design. Usage of internal cavities of carbon nanotubes (CNTs) may be a solution, both as a catalyst support and chemical nanoreactor.

The aim of this work was to examine the activity and selectivity of Pd-Cu active phase located inside the carbon nanotubes – the confinement effect. Due to more accurate analysis of this effect, catalytic behavior of the metal nanoparticles deposited on the CNT exterior walls was also tested. Positioning of the active metal phase, i.e. exclusively inside or outside the CNTs, was promoted by previous CNTs cutting (via catalytic oxidation) and using solvents of different surface tension.

The results of catalytic tests revealed the hindering effect of confined metal nanoparticles, while the externally deposited ones can be portrayed by superior performances in terms of both their activity and selectivity. The unexpected result was explained by a negative impact of confined particles due to their electron deficiency, as well as their size determining the second step of denitration reaction as a structure sensitive one.