Nanoparticles for clean drinking water

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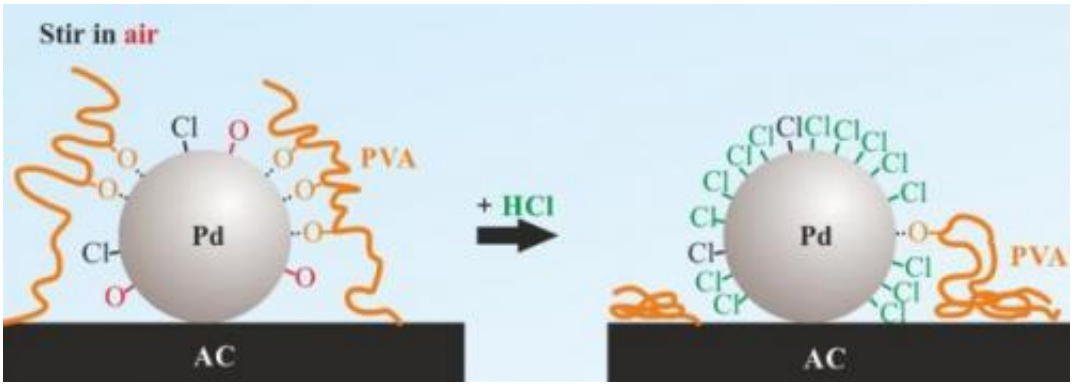

One way of removing harmful nitrate from drinking water is to catalyse its conversion to nitrogen. This process suffers from the drawback that it often produces ammonia. By using palladium nanoparticles as a catalyst, and by carefully controlling their size, this drawback can be partially eliminated. It was research conducted by Yingnan Zhao of the University of Twente's MESA+ Institute for Nanotechnology that led to this discovery.

Due to the excessive use of fertilizers, our groundwater is contaminated with nitrates, which pose a problem if they enter the mains water supply. Levels have fallen significantly in recent years, as a result of various European directives. In addition, the Integrated Approach to Nitrogen programme was launched in various Dutch nature reserves at the start of January. Tackling the problem at source is one thing, but it will still be

necessary to treat the mains water supply. While this can be achieved through biological conversion (using bacteria to convert the nitrate to nitrogen gas), this is a slow process. Using palladium to catalyse the conversion of nitrate to nitrogen speeds up the process enormously. However, this reaction suffers from the drawback that it produces a harmful by-product – ammonia.

Exposed surface

The amount of ammonia produced appears to depend on the method used to prepare the palladium and on the catalyst's physical structure. Yingnan Zhao decided to use nanometre-sized colloidal palladium particles, as their dimensions can be easily controlled. These particles are fixed to a surface, so they do not end up in the mains water supply. However, it is important to stop them clumping together, so stabilizers such as polyvinyl alcohol are added. Unfortunately, these stabilizers tend to shield the surface of the palladium particles, which reduces their effectiveness as a catalyst. By introducing additional treatments, Yingnan Zhao has managed to fully expose the catalytic surface once again or to manipulate it in a controlled manner. This has resulted in palladium nanoparticles that can catalyse the conversion to nitrogen, while producing very little ammonia. This has brought the further development of catalytic water treatment (in compact devices for home use, for example) one step closer.

Yingnan Zhao, who is from Heze, Shandong, China, conducted his research in Prof. Leon Lefferts' Catalytic Processes and Materials group. He defended his thesis, which is entitled "Colloidal Nanoparticles as Catalysts and Catalyst Precursors for Nitrite Hydrogenation" on Thursday 15 January.

Provided by University of Twente