3D material found to break down antidepressant that contaminates water bodies worldwide

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A study published in the *Chemical Engineering Journal* describes a strategy to produce a material based on zinc oxide (ZnO) capable of

degrading sertraline, an antidepressant that has been detected, like other drugs, in groundwater worldwide and is considered an emerging pollutant. This kind of substance has certain physicochemical properties that hinder removal by conventional wastewater treatment methods.

The research was conducted in Brazil by scientists at the Center for Development of Functional Materials (CDMF), the Brazilian Agricultural Research Corporation (EMBRAPA), the Federal University of Alfenas (UNIFIL), and the Federal University of Paraíba (UFPB).

The strategy described in the article involved the experimental design and microwave-assisted solvothermal synthesis (MASS) in producing hierarchical 3D ZnO photocatalysts capable of degrading sertraline with a high-efficiency level in only ten minutes.

The researchers deployed principal component analysis (PCA), hitherto little used in materials synthesis, to correlate the physicochemical and photocatalytic properties of the materials with the synthetic conditions investigated. The results showed that chemometric tools yield excellent results in studying synthetic systems that generate large amounts of experimental data.

The samples with the most potential for environmental remediation were identified. The photocatalytic activity of 3D ZnO efficiently degraded an organic dye and the emerging pollutant sertraline in natural water. The results confirmed that the 3D ZnO absorbed light energy (ultraviolet A and C) to promote efficient water photo-oxidation, producing oxidizing species that degrade organic contaminants.

Degradation performance remained high in up to five cycles of application, conserving crystal structure, morphology, and other properties, while phytotoxicity assays showed that byproducts formed in the sertraline degradation process were not toxic to the organisms tested,

confirming the safety of the photocatalyst for wastewater treatment.

The study results were competitive with other materials reported in the literature, showing that the materials obtained in advantageous synthetic conditions offer a genuine route to the development of novel technologies for environmental remediation of emerging pollutants in natural water.

According to Ailton Moreira, a researcher at CDMF and corresponding author of the article, improper disposal of pharmaceuticals is causing widespread contamination, he added, noting the current relevance of the topic in light of the risks to human health and the environment.

The choice of sertraline was significant, he explained, because the number of studies involving the application of heterogeneous photocatalysis for sertraline degradation is very limited, and the researchers' review of the literature found none on the use of ZnO for this purpose.

The next steps include analyzing the performance of the photocatalyst in real wastewater treatment systems to see if it breaks down sertraline and other emerging pollutants individually or in more complex mixtures such as hospital or domestic wastewater processed by sewage treatment plants. These and other researchers plan to focus on a Gavião Peixoto, São Paulo state treatment plant.

More information: Thalles E.M. Silva et al, Hierarchical structure of 3D ZnO experimentally designed to achieve high performance in the sertraline photocatalysis in natural waters, *Chemical Engineering Journal* (2023). DOI: 10.1016/j.cej.2023.146235

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