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A 3D-printed self-propelled, highly sensitive mini-motor for underwater pesticide detection

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Abstract

A three-dimensionally printed self-propelled mini-motor (SPM) for the detection of underwater pollutants is proposed. The device uses highly sensitive metal nanoparticles for colorimetric monitoring. Gold nanoparticles covered with Rhodamine B (RB-AuNPs) were prepared, based on established colorimetric and fluorometric approaches for detecting pesticides. The detection mechanism monitors the inhibition of the activity of acetylcholinesterase (AChE) by the pesticide, in which the production of thiocholine from the hydrolysis of acetylthiocholine (ATCh) catalyzed by AChE is reduced. As a result, the color of the RB-AuNP solution remains red, and the fluorescence of RB remains quenched. The RB-AuNPs were characterized by transmission electron microscopy (TEM), UV-Vis absorption spectroscopy, and X-ray photoelectron spectroscopy (XPS). Under the optimized experimental conditions, excellent reproducibility (with a relative standard deviation of 5.8%) and low sensitivity limits, ranging from 0.4 to 3.0 μg L^{-1}, were achieved. The limit of quantity (LOQ) was 0.3 μg L^{-1},and the detection limit (LOD) was