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**Multi-functional nanohybrid of ultrathin molybdenum disulfide  
nanosheets decorated with cerium oxide nanoparticles for  
preferential uptake of lead (II) ions**

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**Abstract:** Molybdenum disulfide-based 2D nanomaterials have become an attractive target for investigations in various fields. However, their potential application in the important area of environmental science has not yet been effectively explored. In this work, ultrathin molybdenum disulfide nanosheets decorated with cerium oxide nanoparticles (MoS<sub>2</sub>/CeO<sub>2</sub>) nanohybrids were synthesized using a two-step hydrothermal reaction and used to remove Pb<sup>2+</sup> as a representative heavy metal ion. A detailed characterization, including transmission electron microscopy (TEM), Fourier transform infrared (FT-IR) spectrum, X-ray photoelectron spectroscopy (XPS), and thermogravimetric analysis (TGA), confirmed the formation of the MoS<sub>2</sub>/CeO<sub>2</sub> nanohybrids. Furthermore, different factors affecting the sorption process, such as pH, adsorbent amount, contact time, ion strength, and reusability, were studied in detail. The adsorption kinetic data were described well with the pseudo-second-order model, and the equilibrium data were fitted well to Langmuir isotherms.

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