

A Novel High-Throughput Chaotic Advection Microreactor for the Preparation of Uniform BaSO₄ Nanoparticles

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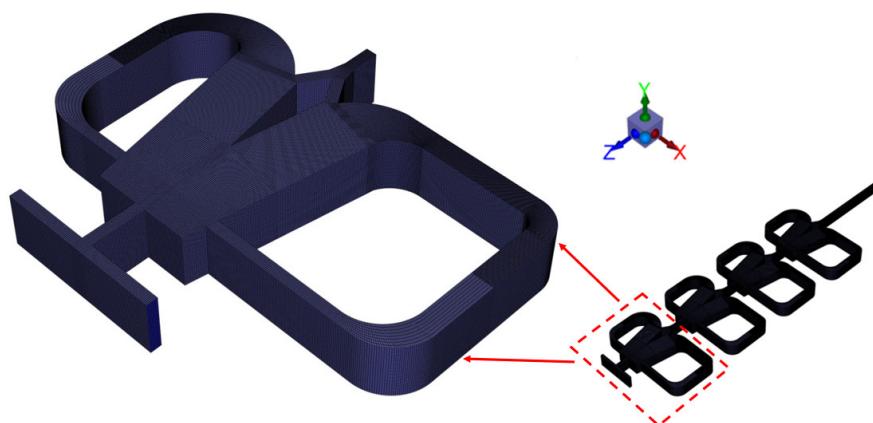
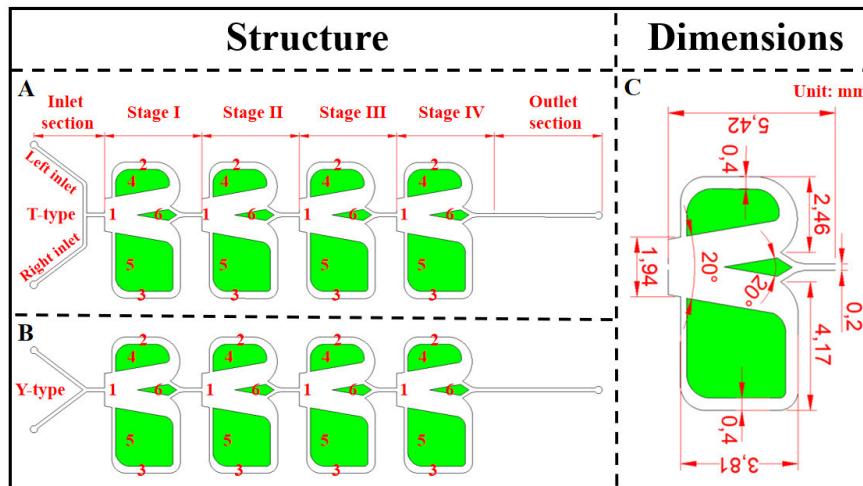
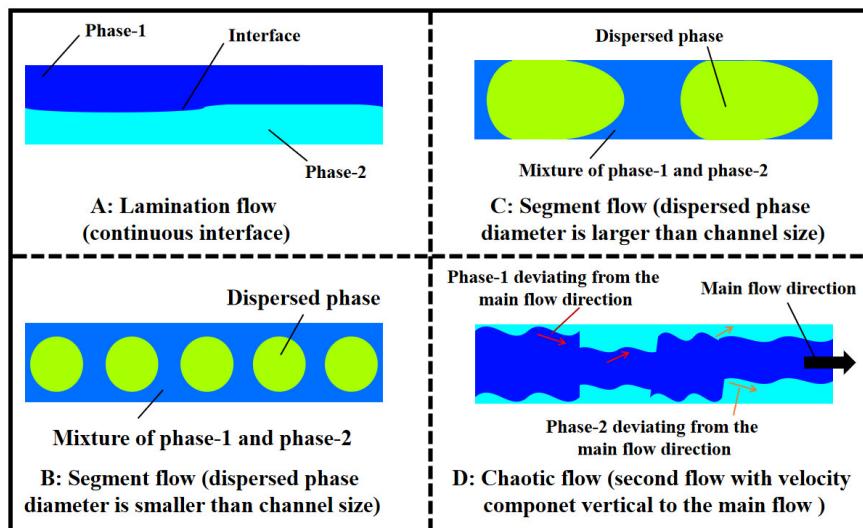
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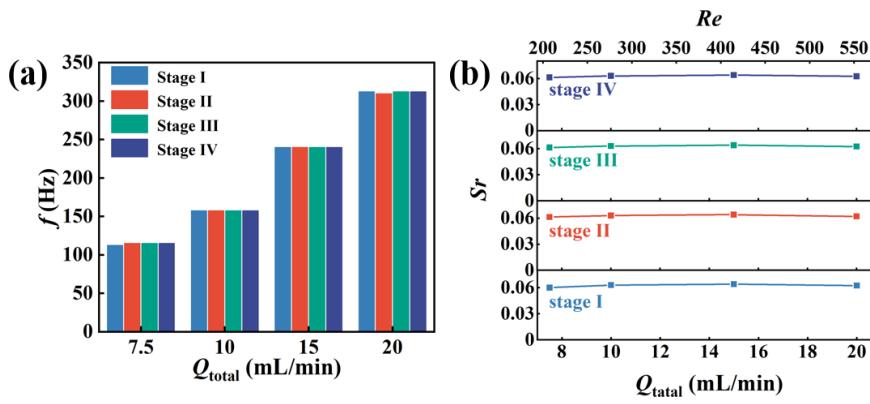
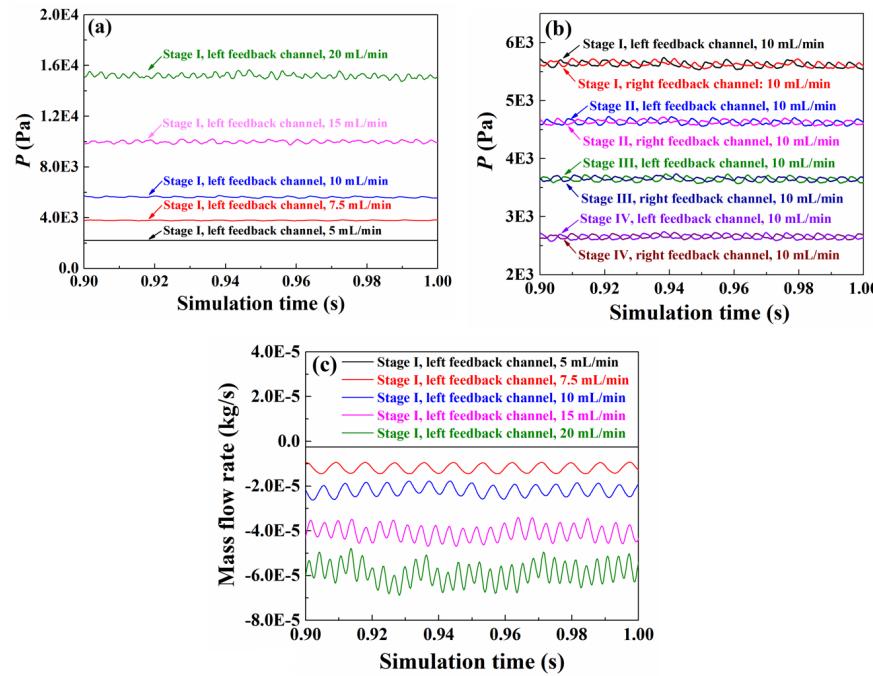
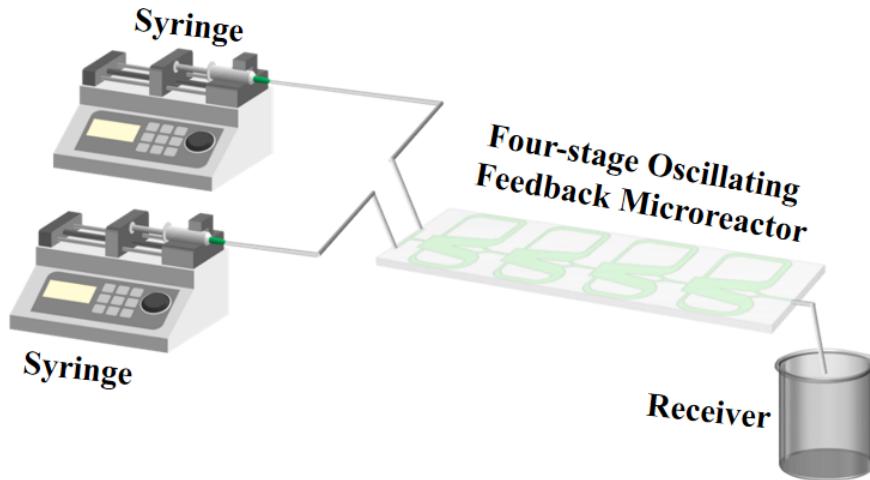
Abstract

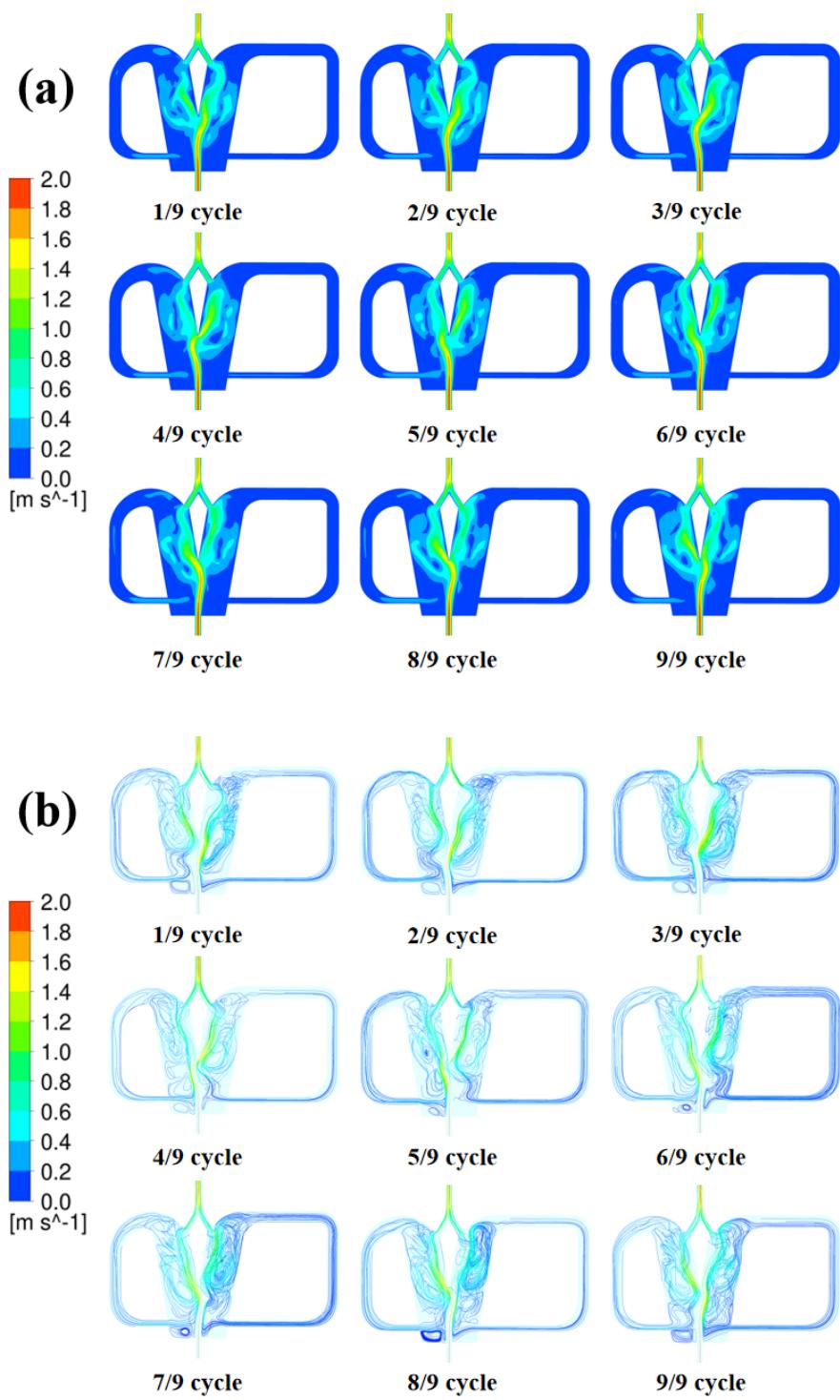
Owing to high mixing efficiency, microreactors are used to synthesize uniform BaSO₄ nanoparticles, but application in industrial scale is limited due to poor throughput. In this work, a high-throughput passive four-stage asymmetric oscillating feedback microreactor using chaotic mixing mechanism was developed to prepare BaSO₄ nanoparticles of high size uniformity. Three-dimensional unsteady simulations showed that chaotic mixing could be induced by three unique secondary flows (i.e., vortex, recirculation, and oscillation), and the fluid oscillation mechanism was examined in detail. Simulations and Villermaux-Dushman experiments indicate that almost complete mixing in molecular level could be achieved when total volumetric flow rate Q_{total} was larger than 10 mL/min, and the prepared BaSO₄ nanoparticles were with narrow particle size distribution (PSD). Through the adjustment of Q_{total} and reactant concentrations, it is easy to control the average size. An average size of 26 nm with narrow PSD could be achieved at $Q_{\text{total}} = 160$ mL/min.

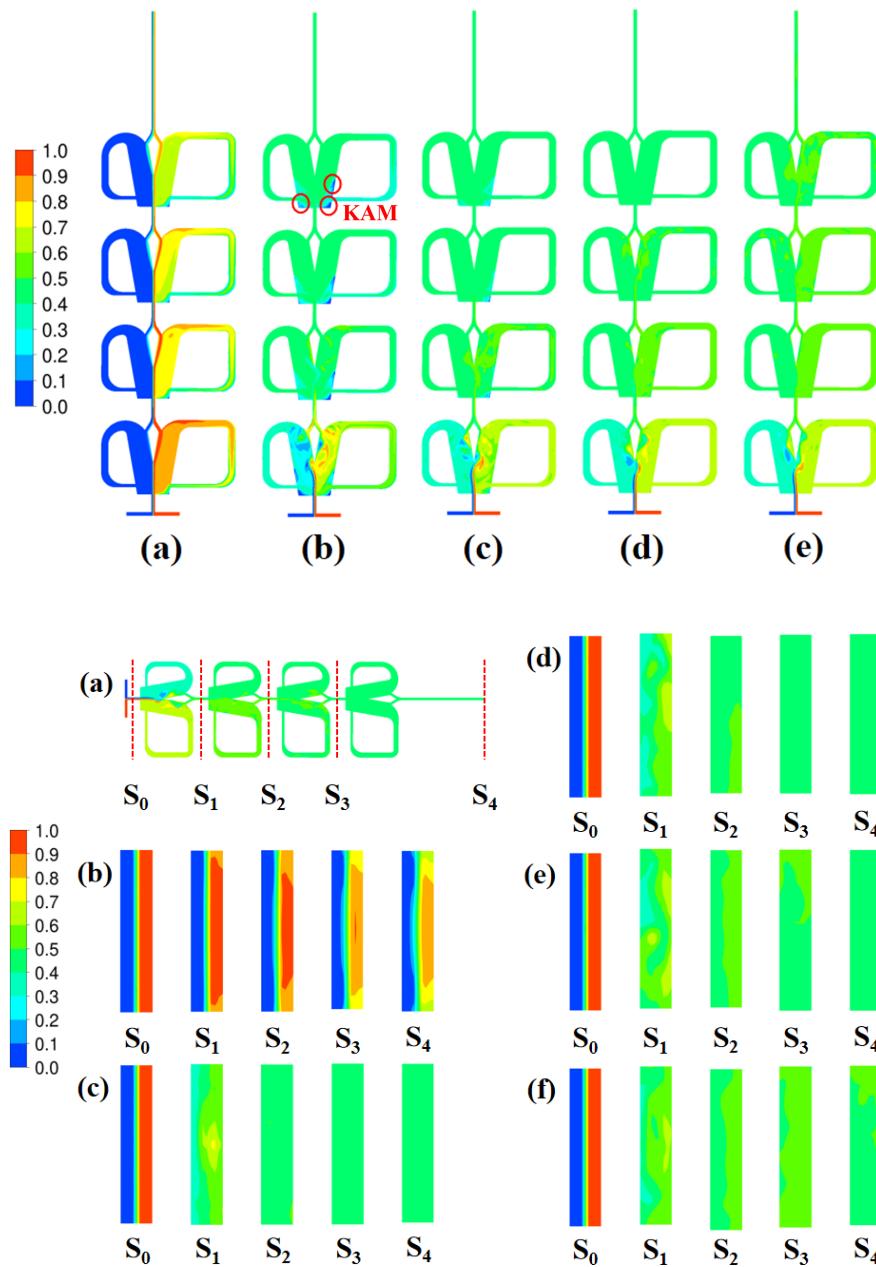
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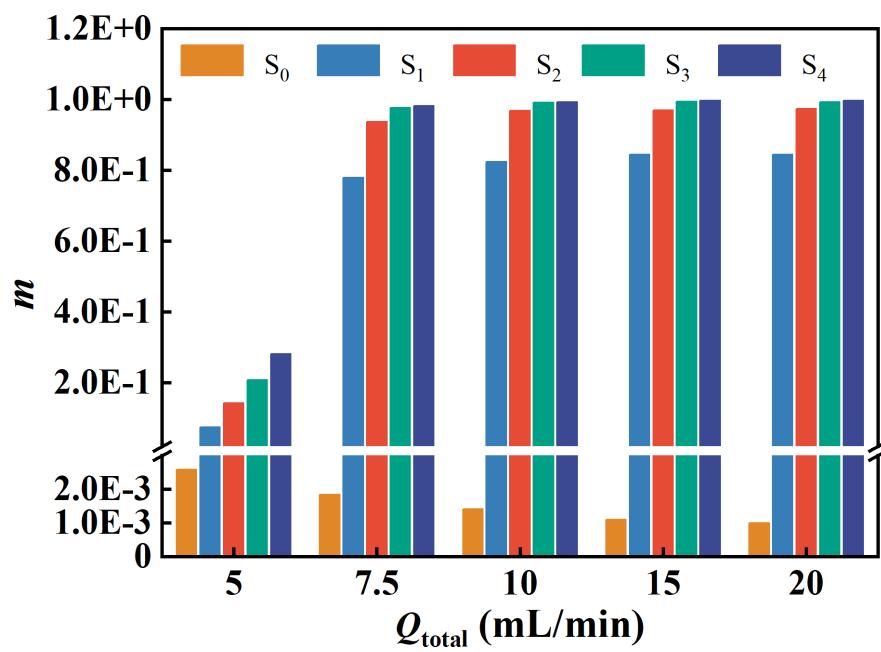
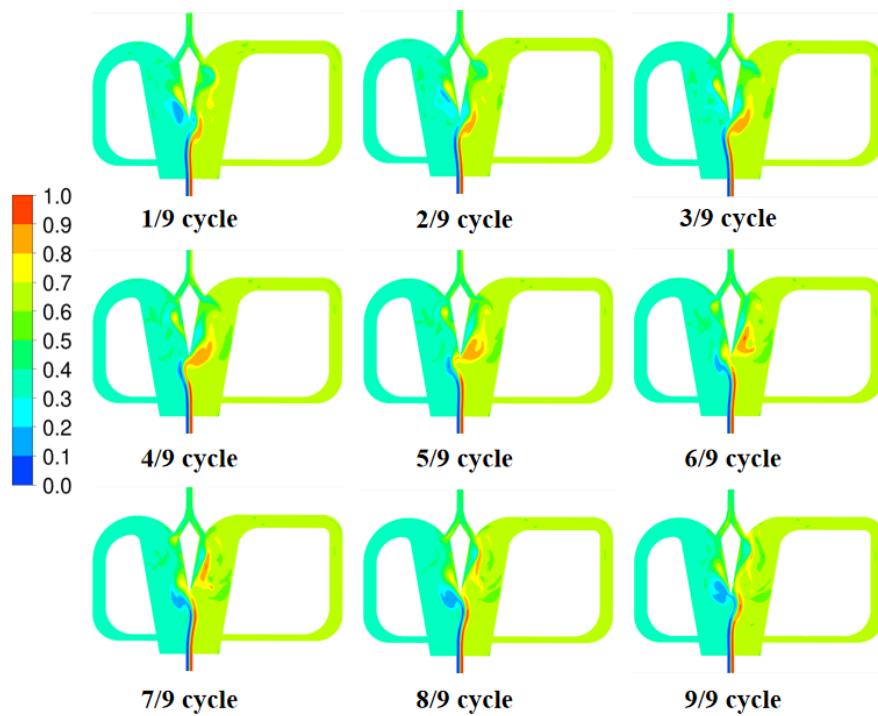
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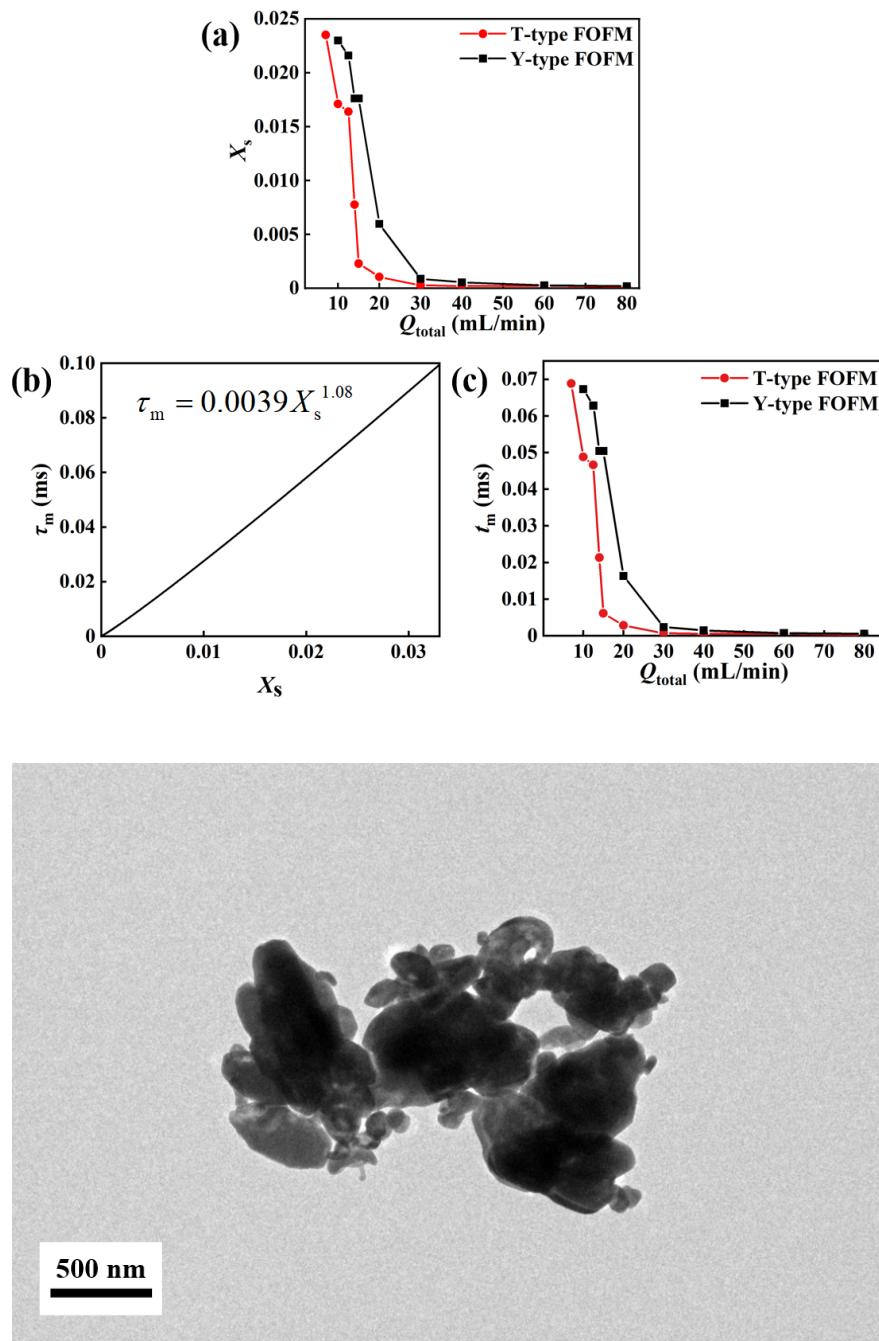


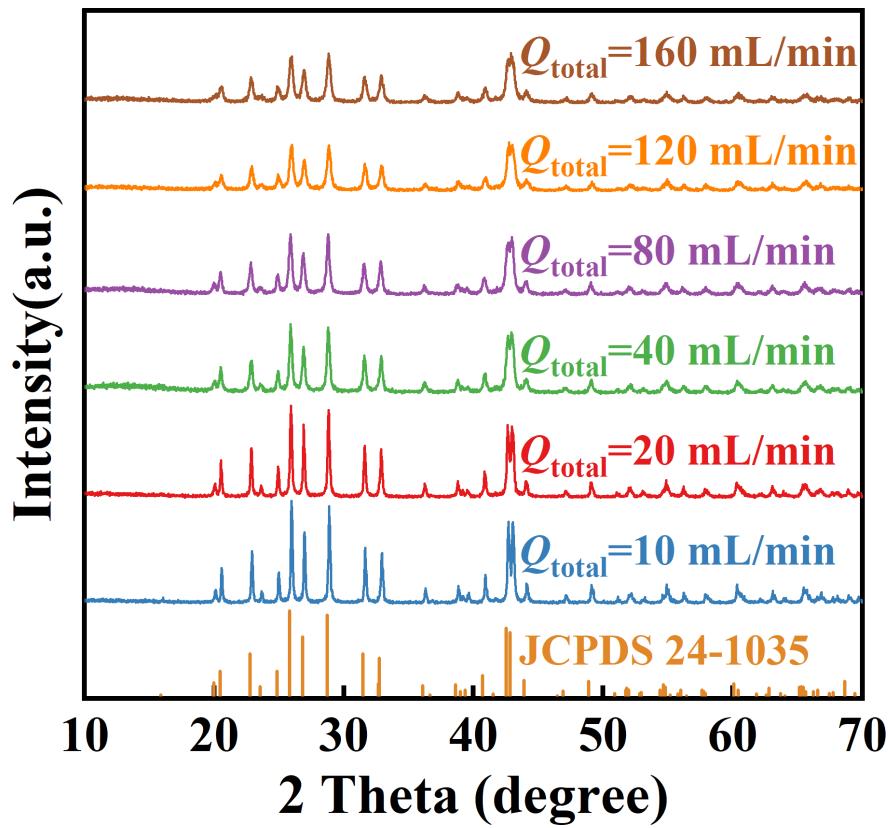


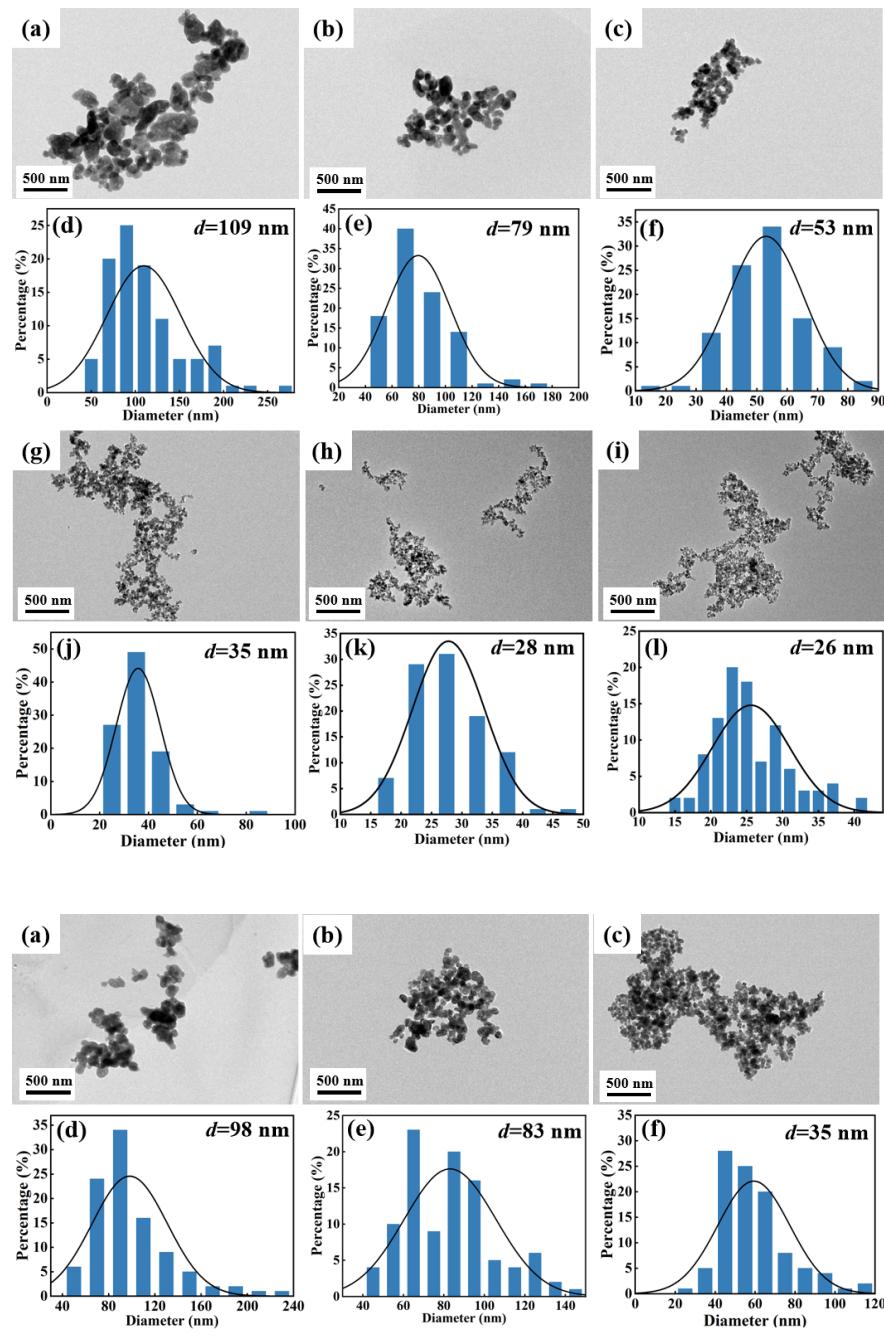


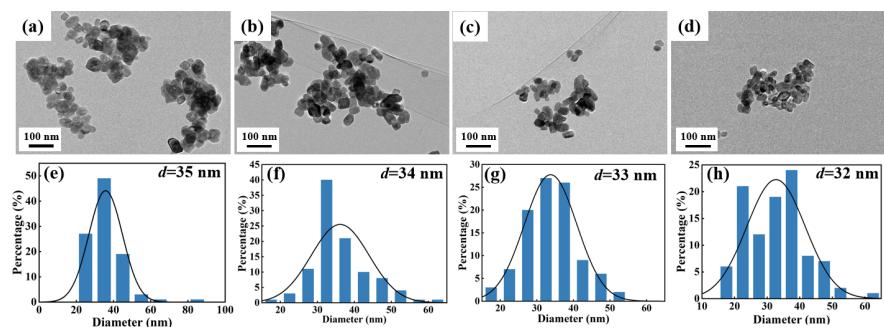
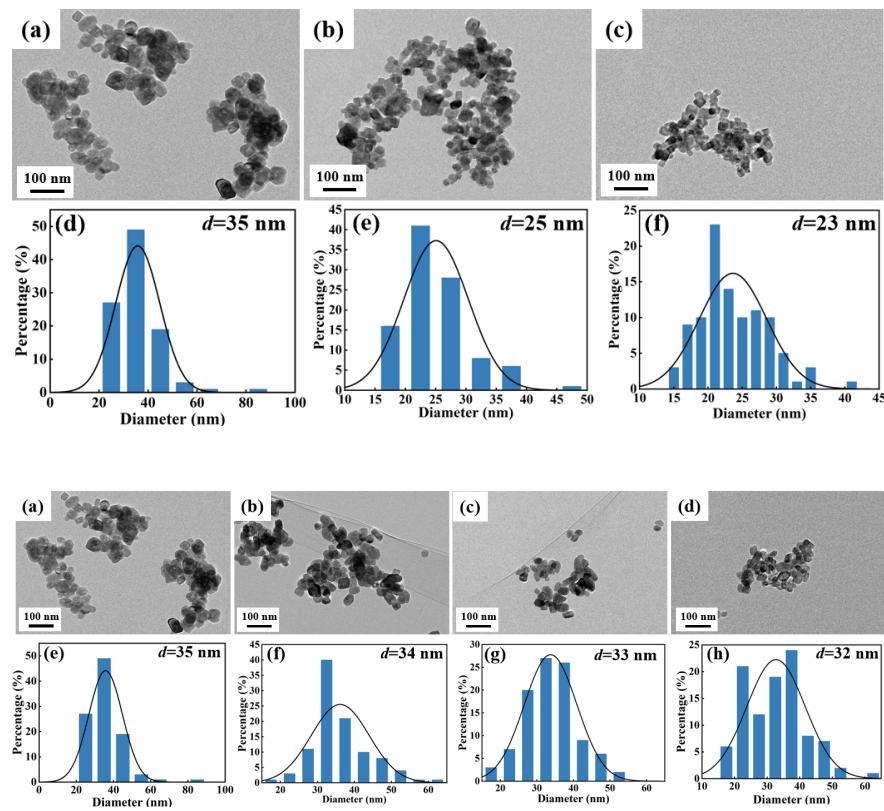












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