

## Meso-structured Onion-Like Silica for Enzyme Immobilization

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Meso-structured onion-like silica (Meso-Onion-S) was prepared and used as a host of enzyme immobilization. Meso-Onion-S is comprised of 100~200 nm sized onion building unit. Each onion have well developed 10 nm sized mesopores with multi-shell structures and onion size is relatively uniform. Scanning electron microscopic image shows that a few hundred nanometer sized onions are aggregated into secondary micrometer sized particles. To take advantage of unique structure of Meso-Onion-S, we employed the ship-in-a-bottle approach by adsorbing enzymes and subsequent enzyme crosslinking, which effectively prevents the enzyme leaching from Meso-Onion-S. The resulting nanoscale enzyme reactors have high capacity of enzyme loading. For example, 400 mg of  $\alpha$ -chymotrypsin (CT) could be adsorbed into 1 g of Meso-Onion-S within 10 min. NERs of lipase (LP) resulted in a high enzyme loading and significantly increased the enzyme stability. For example, NER-LP was stable under rigorous shaking for 40 days, while the control sample of adsorbed LP showed a rapid inactivation due to rigorous enzyme leaching.