Metal Oxide Nanoparticles Encapsulated in Porous Polymer Microparticles for Modulating Hydrogen Sulfide Concentrations Towards Colorectal Cancer Treatment

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Fusobacterium nucleatum is a key exogenous hydrogen sulfide (H_2S) producer in the bowel. The concentration of H_2S in healthy people ranges from 250 µm – 3.4 mM[1] and is significantly higher in people with bowel conditions such as inflammatory bowel disease (IBD) and colorectal cancer (CRC).[2,3] People with CRC are unable to effectively detoxify H_2S.[4] Bismuth subsalicylate, a current treatment for reducing H_2S in the colon, is not recommended for long-term use due to risk of severe neurological side effects.[5] We present metal oxide nanoparticles encapsulated in porous polymer microparticles that are capable of adsorbing H_2S via a simple reaction where water is the sole by-product (Eq. 1). CuO nanoparticles (50 nm) were encapsulated within porous poly(methyl methacrylate) (PMMA) microparticles (PMMA/CuO particles) via a water-in-oil-in-water double emulsion. The PMMA/CuO particles have an average diameter of 465 ± 25 µm and ~2-10 µm pore size (Fig.1A). Methylene blue assay confirmed that clinically relevant amounts of PMMA/CuO particles (2 mg with 5 wt.% CuO) can adsorb 98% of H_2S produced by *Fusobacterium nucleatum* within 60 min (Fig.1B). These particles may prove useful in the prevention and treatment of exogenously elevated H_2S levels in bowel conditions and CRC.

$$H_2S + CuO \rightarrow CuS + H_2O \qquad (1)$$

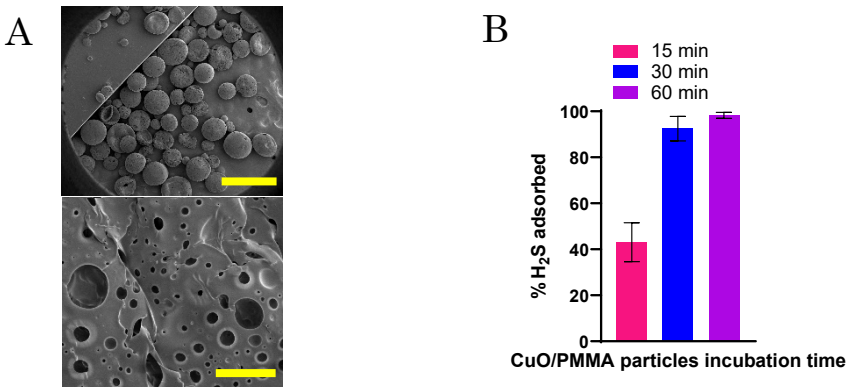

Figure 1: (A) Scanning electron microscopy micrographs of PMMA/CuO particles; Scale bar: 1 mm (top) and 10 µm (bottom). **(B)** Percentage of H_2S adsorbed by 2 mg/mL PMMA/CuO particles over time (15, 30, and 60 min). H_2S was produced by incubating ~1.4 x 10^8 *Fusobacterium nucleatum* with 20 mM L-cysteine for 30 min.

References:

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