

# Polymer-metal oxide nanoformulation to adsorb hydrogen sulfide for improved bowel health

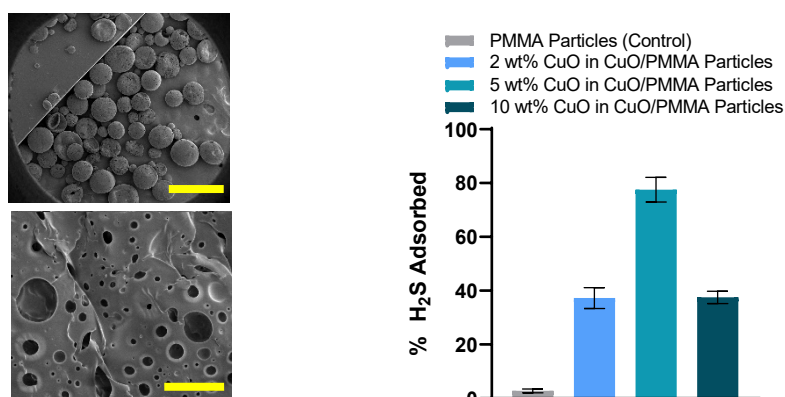
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Hydrogen sulfide (H<sub>2</sub>S) is a gasotransmitter responsible for modulating inflammatory responses in the colon. Bowel conditions, such as small intestinal bacterial overgrowth and irritable bowel syndrome, have been associated with elevated levels of H<sub>2</sub>S.<sup>1</sup> People with these conditions are more likely to develop colorectal cancer (CRC)<sup>2</sup> which is the second deadliest cancer in Australia and kills 103 people each week.<sup>3</sup> There are three H<sub>2</sub>S producing pathways in the colon: dietary, endogenous (via enzymes) and bacterial. Treatments to reduce H<sub>2</sub>S in the colon are limited to antibiotics, low sulfur diets and the use of bismuth subsalicylate which cannot be used long term without adverse side effects. We present an approach to reduce H<sub>2</sub>S concentration in the colon using copper oxide nanoparticles (CuO NPs) which adsorb H<sub>2</sub>S via a simple reaction (Eq.1). We encapsulate CuO NPs within a porous polymethylmethacrylate (PMMA) microparticle (CuO/PMMA particles) (Fig.1) whose size prevents CuO adsorption through the colon walls and is also large enough to be captured in wastewater treatment. Methylene blue assay was used to confirm that clinically relevant amounts of CuO/PMMA particles (2 mg with 5 wt.% CuO) can adsorb 77.5% 550 μM H<sub>2</sub>S in 1 mL solution in 30 mins, (Fig.2). These particles may prove useful in the prevention and treatment of elevated H<sub>2</sub>S levels in bowel conditions and CRC.



**Figure 1:** Scanning electron microscopy micrographs of CuO/PMMA particles; Scale bar: 1 mm (top) and 10 μm (bottom).

**Figure 2:** Percentage of 550 μM H<sub>2</sub>S adsorbed in 1 mL after 30 mins exposure to 2 mg PMMA or CuO/PMMA particles.

<sup>1</sup> F. Blachier. et al. *American Journal of Physiology-Gastrointestinal and Liver Physiology* **2021**, 320, G125-G135

<sup>2</sup> J. Axelrad. et al. *World J Gastroenterol* **2016**, 22, 4794-4801

<sup>3</sup> Bowel Cancer Australia, Bowel Cancer Facts, **2023** <https://www.bowelcanceraustralia.org/facts> (Accessed 7/3/23)

<sup>4</sup> S. Wang. Et al. *Front Cell Dev Biol* **2021**, 9, 710165