Oleate-covered CuOx Polyhedral Nanoparticles as a Potential Material Against Pathogens

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Antimicrobial nanoparticles (NPs) have shown promise in various applications, such as medical devices, wound dressings, textiles, water purification systems, and food packaging materials. The properties of these particles arise from their small size, high surface area and unique physicochemical properties, which promotes several antimicrobial mechanisms routes (e.g., physical damage, oxidative stress, enzyme inhibition, nanoparticle uptake), with frequent synergistic effects. Beyond their pronounced antimicrobial attributes, nanoparticlemediated therapeutics offer distinct advantages regarding the conventional antibiotics, notoriously heightened stability, attenuated cytotoxicity, target specificity and prevention of antimicrobial resistance.

Amongst these materials, copper oxide (CuOx) NPs have emerged as an important antimicrobial material. The antimicrobial effects of CuOx nanoparticles primarily stem from their capacity to discharge copper ions (responsible for the disrupting vital microbial biochemical processes) and to generate reactive oxygen species (ROS), causing oxidative stress within microbial cells.

Additionally, antimicrobial effects of CuOx NPs characteristics can be improved by tailoring their dimensions, morphology and exposed crystallographic facets, resulting in a high performance with a smaller amount of NPs, which provides proper uses in a subchronic toxicity scenario. Given this context, we present an easy and effective microwave-assisted biphasic synthesis route for the fabrication of CuOx nanoparticles, through hierarchical assembly of nanoparticle building blocks into ordered superstructures.

By systematically adjusting precursor concentrations, reaction time, colloid deposition parameters, and microwave energy, it was produced CuOx nanoparticles with precisely controlled dimensions, morphologies, and crystallographic facet exposures ((100), (111), and (110)), according to the transmission electron microscopy characterizations. These results provide a promising avenue toward the production of highly effective antimicrobial NPs.

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