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Hybrid CuNP/CNC and CuNP/ChNC nanoparticles: Synthesis, Characterisation and Prospective Uses

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Abstract: Copper nanoparticle/cellulose nanocrystal and copper nanoparticle/chitin nanocrystal hybrids were synthesised using two different approaches. The hybrid nanoparticles were characterised using several analytical methods. Potential applications of these hybrids are explored.

Copper nanoparticles (CuNPs) are inexpensive, abundant, and possess many exploitable physicochemical properties including UV/Vis sensitivity and electrical, thermal, catalytic and antifungal/antibacterial activity. Cellulose nanocrystals (CNC) and chitin nanocrystals (ChNC) are well-known for their high tensile strength and their roles as biocompatible, biodegradable and nontoxic passive and active supports for inorganic nanoparticles. CuNP/CNC and CuNP/ChNC hybrids were synthesised using green synthesis methods.

Hydrothermal treatment (HTT) was used as one method of hybridisation. Here, CuNPs, CNC, and ChNC were synthesised separately before HTT was used to generate electrostatic attraction between the nanoparticles to create the hybrid. The other method involved the *in-situ* formation of the CuNPs directly on CNC and ChNC surfaces. Here, Fenton systems were used to functionalise both CNC and ChNC and introduce carboxyl functional groups – making the polysaccharide nanoparticles more susceptible to *in-situ* hybridisation.

The size and zeta potential of each hybrid were determined. Hybrid sols, films and powders were characterised using UV/Vis spectroscopy, transmission electron microscopy (TEM), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR). The colloidal chemical properties of the hybrid particles were investigated for potential applications.

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