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ENVIRONMENTALLY-FRIENDLY AU@CNC HYBRID NANOPARTICLE SYNTHESIS FOR HUMIDITY SENSORS

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Both cellulose nanocrystals and gold nanoparticles show immense potential for biochemical and chemical applications. Unstable colloidal gold nanoparticles are hybridised with cellulose nanocrystals to form stable, active inorganic-organic hybrids via hydrothermal treatment. The gold nanoparticle/cellulose nanocrystal hybrid responds to changes in humidity.

Due to their unique properties and applications, gold nanoparticles (AuNPs) have attracted much attention. AuNPs are one of the most effective catalysts for a number of important chemical reactions. Unfortunately, due to the low repulsive forces between particles resulting in a tendency to agglomerate in solution, colloidal gold is generally unstable, leading to the formation of large particles with reduced activity.

As science and technology shift towards more environmentally friendly and sustainable resources and processes, so have the means of improving colloidal gold stability. Polysaccharides, especially cellulose nanocrystals, have emerged as one of the more ideal candidates for “green” supporting materials. By downsizing polysaccharide-based materials to the nanoscale, they have high specific surface area, high dispersibility, and high stability, making them viable catalyst carriers. The deposition of AuNPs on the surface of cellulose nanocrystals opens up a new approach to hybrid heterogeneous catalysts for organic transformations. Be that as it may, to deposit AuNPs on cellulose surfaces it is necessary to either modify one of the components to promote covalent bonding or to “tune” its surface charge to generate electrostatic attraction. Hydrothermal treatment is a low energy green synthesis method which is often used in hybridisations involving biomass.

To conclude, hydrothermal treatment was used to synthesise hybrid Au@CNC nanoparticles. Characterisation of the hybrid Au@CNC sol showed that hybridisation was successful, and that CNCs greatly enhance AuNP stability by minimising homoaggregation. Hybrid Au@CNC films were found to be hygroscopic and responded to changes in humidity. The cellulose matrix is active, autonomously contracting and relaxing with the adsorption and desorption of water molecules in real-time. AuNPs enhance hybrid response to ambient moisture and show a linear dependence on changes in humidity, making the hybrid controllable, highly sensitive, and a viable prospective material for humidity sensing applications.