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Catalytic Activity of metal oxide nanoparticles derived from Electronic waste through green synthesis

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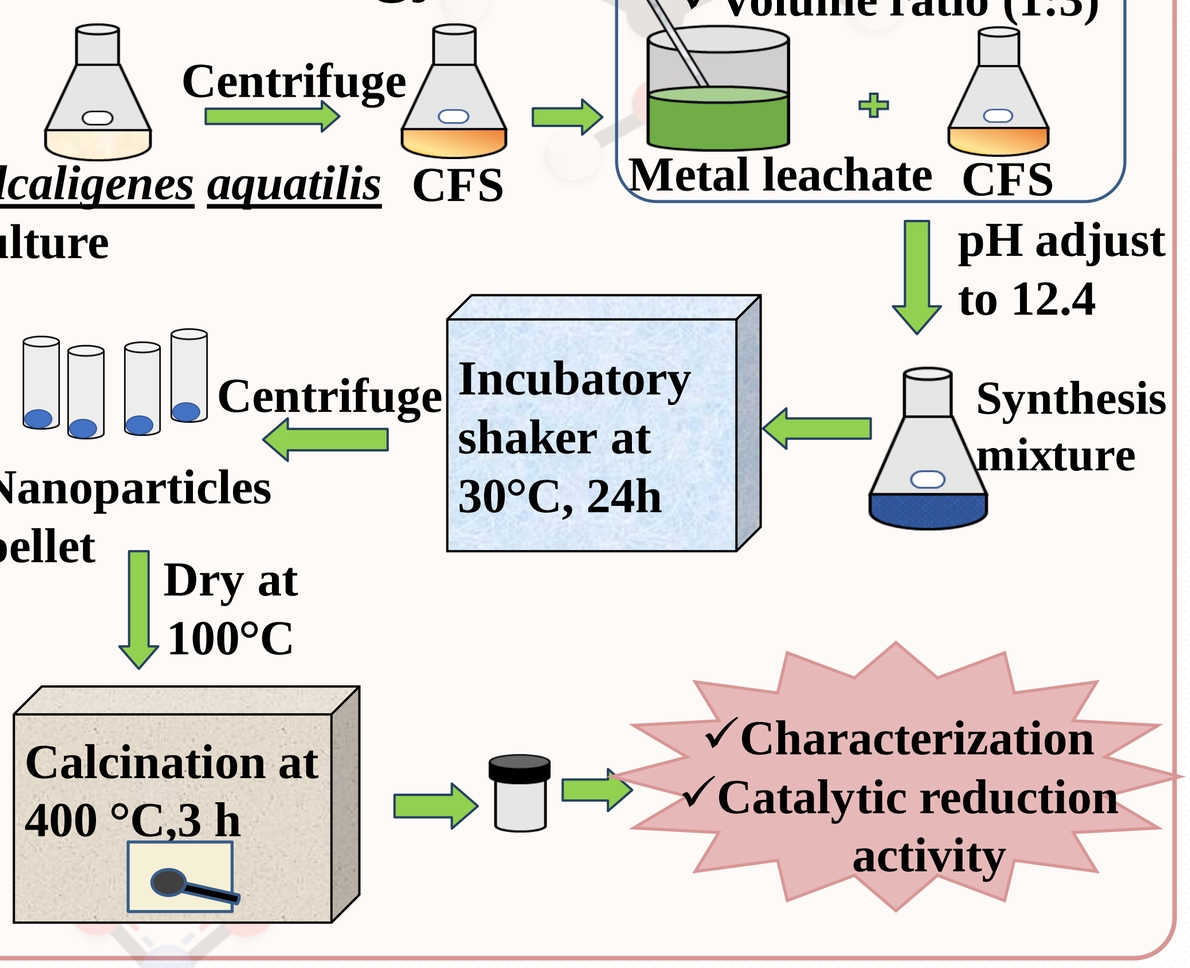
1. Background

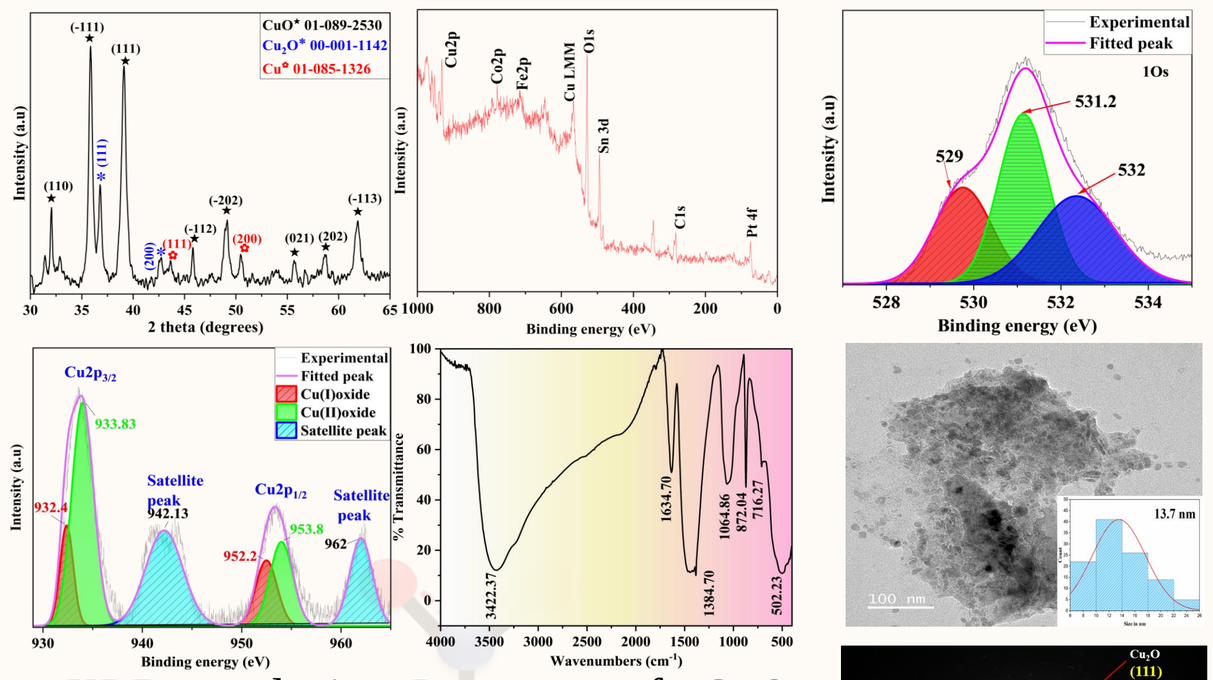
- Electronic Waste (E-Waste) Challenge: Globally, total e-waste generation reached 62 billion kg in 2022. Estimated to increase up to 120 million metric tonnes by 2050.
- Green Nanotechnology: One of the ways to recover and reuse such waste from polluting the landfills and to eliminate the discovery of new mines is the synthesis of nanoparticles using secondary sources
- Cu_xO/Cu-based nanocomposites are synthesized using the cell-free supernatant of *Alcaligenes aquatilis* from the waste-PCBs of mobile phones.
- Nanoparticles that are newly synthesized to evaluate the catalytic activity using a model reaction known as 4-nitrophenol reduction to form 4-aminophenol, an useful intermediate precursors in most of the pharmaceutical industries.

2. Methodology



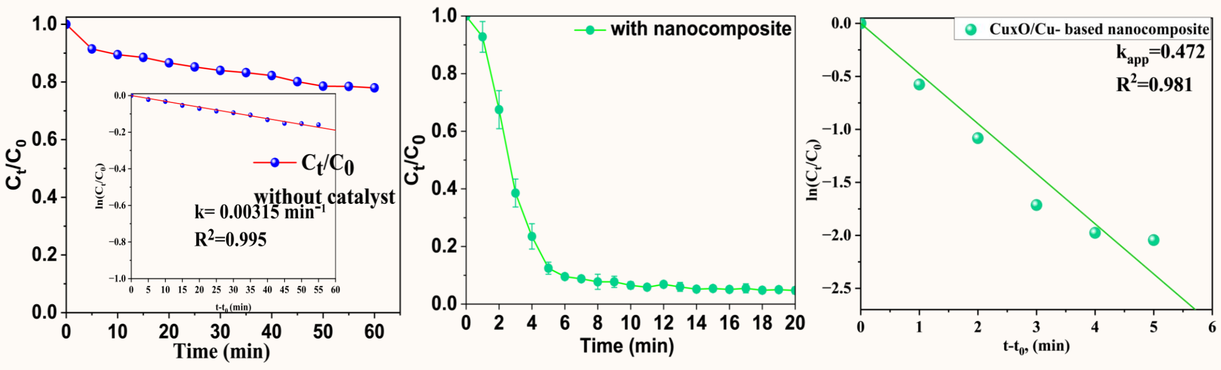
3. Results and discussions

Characterization:



- XRD analysis: Presence of CuO, Cu_2O, and Cu.
- XPS analysis: Presence of multi-metallic elements and oxides of Co_2O_3, PtO_2, FeO, and SnO.
- Deconvoluted peaks of O1s shows the presence of oxides of metals in the lattice and adsorbed water content.
- Deconvoluted peaks: Presence of Cu(I) and Cu(II) oxidation states.
- FTIR: Biological moieties and Cu-O bands
- HRTEM: Average size distribution of 13.7 nm
- SAED pattern: presence of CuO, Cu, and Cu_2O as illustrated in XRD analysis.

Catalytic activity of 4-nitrophenol reduction



- 4-NP reduction without nanocomposite catalyst resulted in a rate constant of 0.00315 min^{-1} with 22% reduction in 30 min.
- Follows pseudo-first-order reaction.
- Addition of Cu_xO/Cu-based nanocomposite catalyst showed catalytic activity of 90.58% in 30 min reduction with a rate constant of 0.47 min^{-1}.

Conclusions:

- ✓ Successfully synthesized Cu_xO/Cu-based nanocomposites from electronic waste using *Alcaligenes aquatilis* bacteria.
- ✓ Catalytically active with 4-nitrophenol reduction of 90.58% and reduction rate constant of 0.47 min^{-1}.

References:

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