GHENT UNIVERSITY

In-situ analysis of conductive films formation by adaptable Cu nanocrystals

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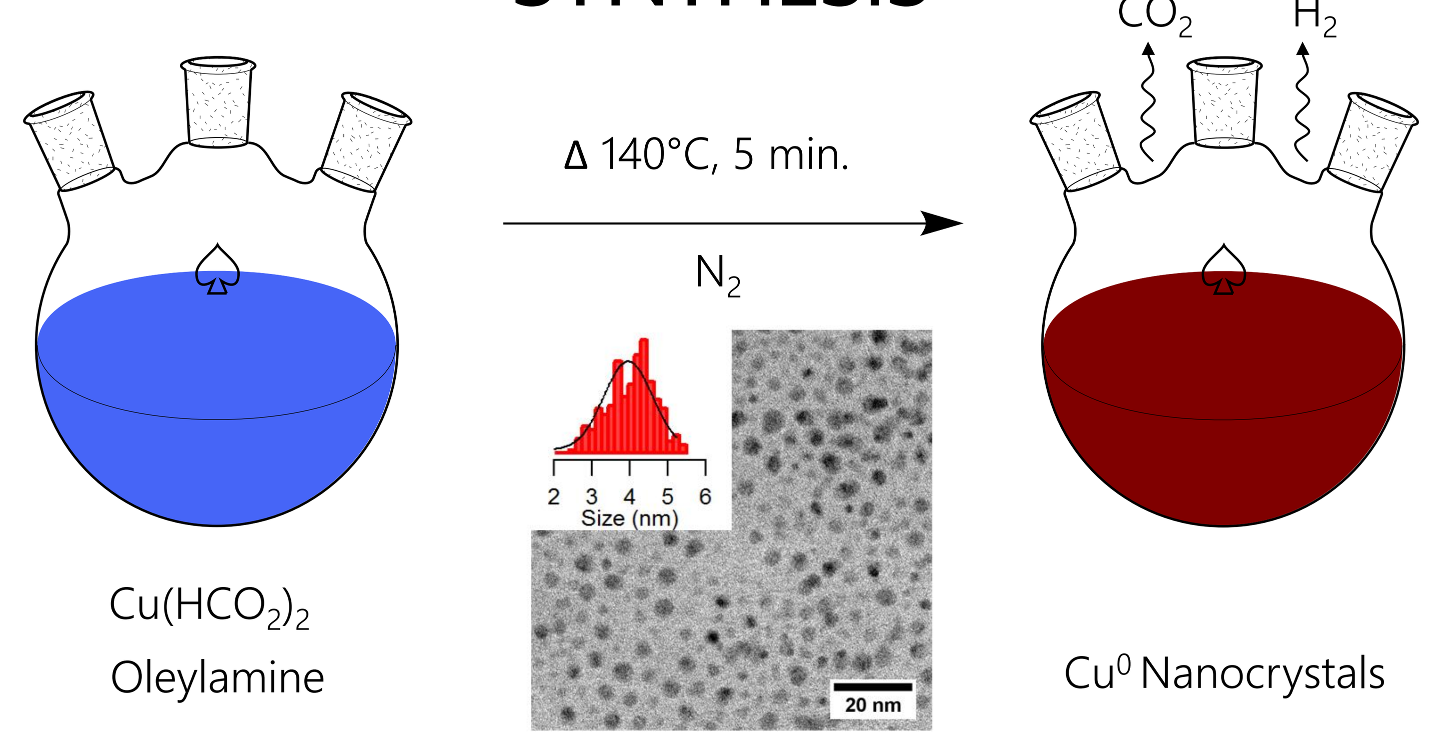
Copper nanocrystals (Cu NCs) are extensively studied for its applications in printed electronics due to their excellent conductive properties. However, its sensibility to oxidation restrains its introduction to the market. An approach to reverse the oxidation and form a compact and conductive film is thermal sintering.

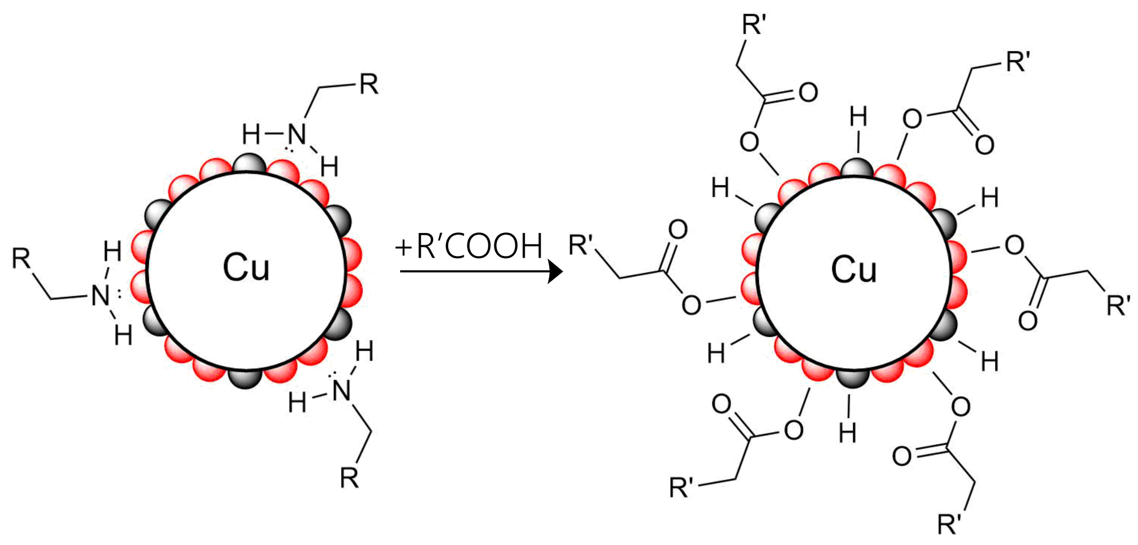
We investigated the effect of:

Surface chemistry and particle size on the sintering of Cu NCs films

SYNTHESIS



SURFACE TUNING

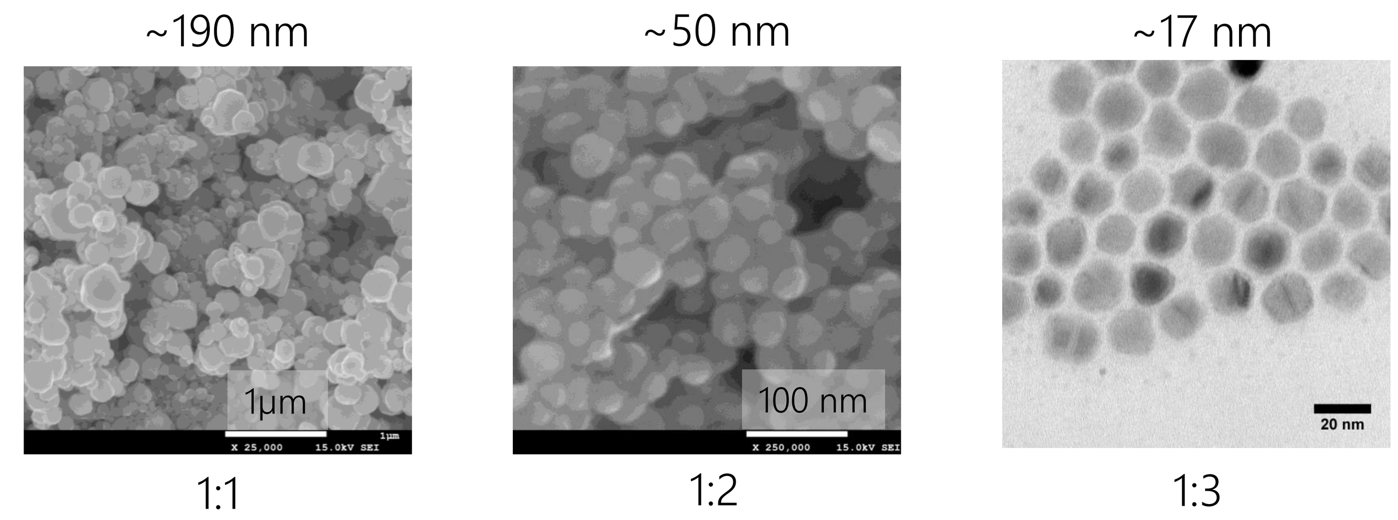


Initial capping ligand oleylamine can be substituted for a carboxylic acid

Surface composition affects:

- Solubility
- Oxidation resistance
- Sintering behavior

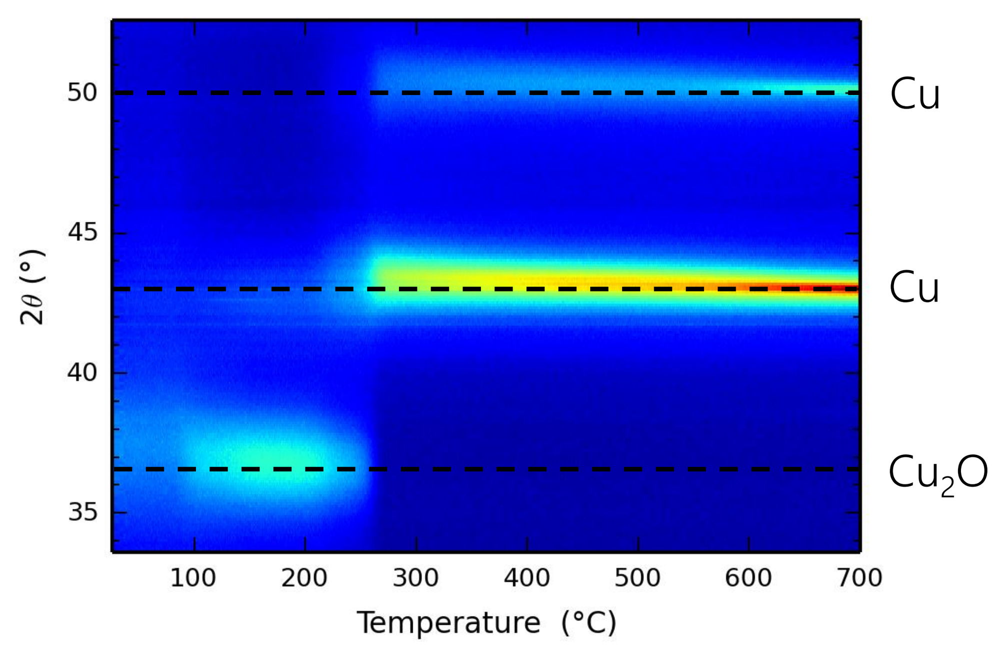
SIZE TUNING



Ratio oleylamine:$Cu(HCO_2)_2$ has a considerable influence on the particle size

OXIDATION REVERSABILITY

Cu NCs oxidize upon air exposure...

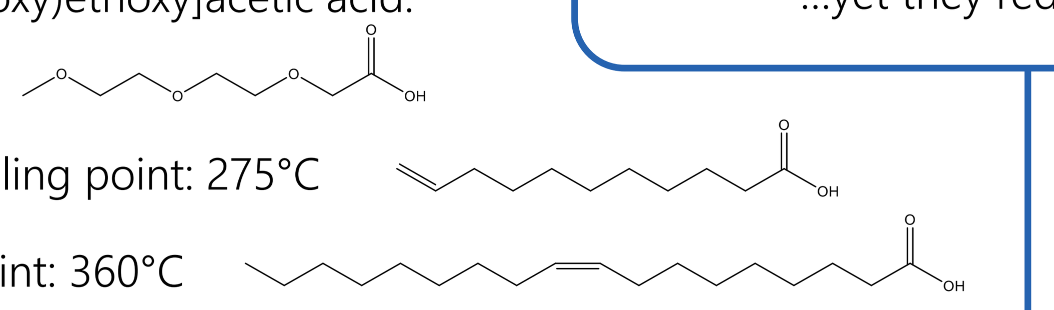


...yet they reduce when sintered

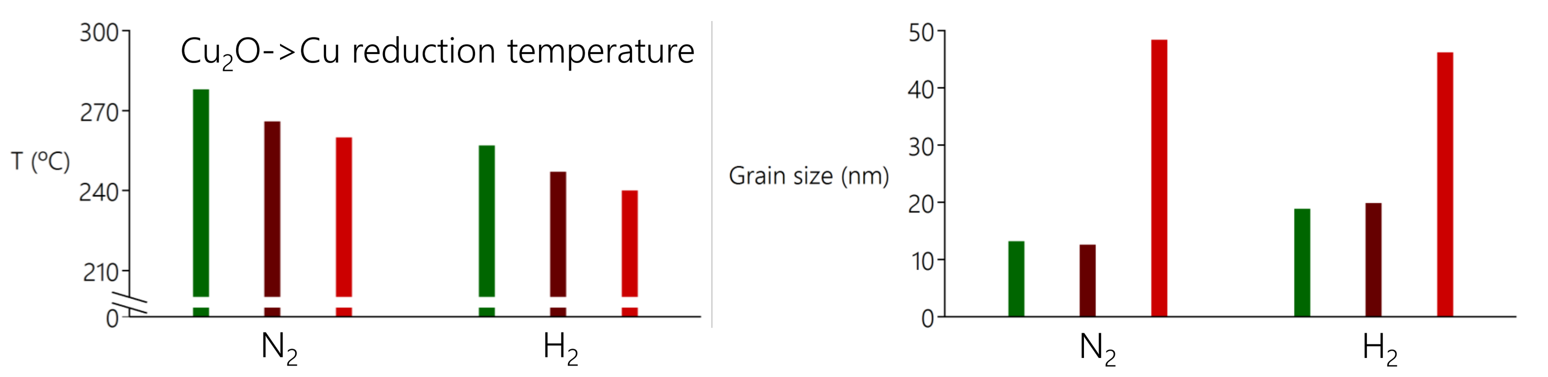
In-situ XRD analysis during sintering

In-situ resistivity analysis during sintering

LIGAND DEPENDENCY

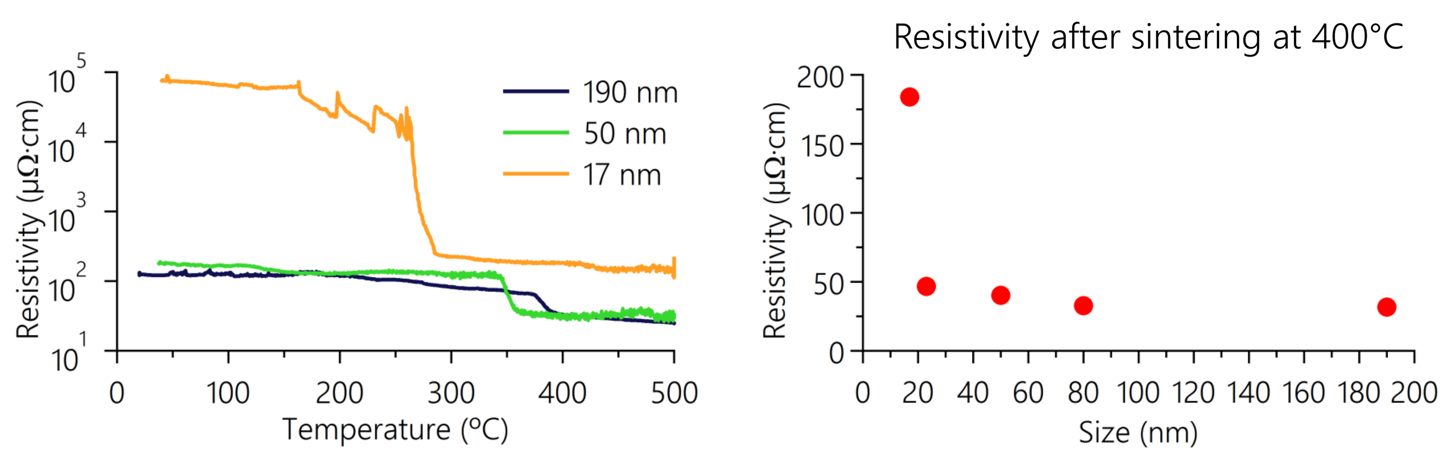


- 2-[2-(2-Methoxyethoxy)ethoxy]acetic acid. Boiling point: 140°C
- Undecylenic Acid. Boiling point: 275°C
- Oleic Acid. Boiling point: 360°C



SIZE DEPENDENCY

Resistance of printed layers has been recorded during sintering using a 4-point probe



Resistivity could be reduced down to 20µΩ·cm after sintering

- A versatile synthesis protocol and a modifiable surface enabled the study of the role of the particle size and surface chemistry during the sintering of Cu NCs.
- Short and volatile ligands are released easily during sintering, facilitating the reduction process and providing larger grain size to the films.
- Large particles present a better inherent conductivity yet they require heavier conditions to fully reduce and sinter.

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NMR & structural analysis unit

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