Carbon free CZTS inks synthesized at room temperature

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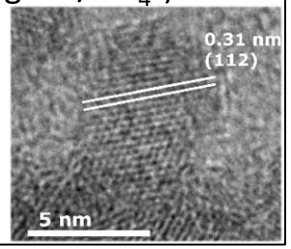
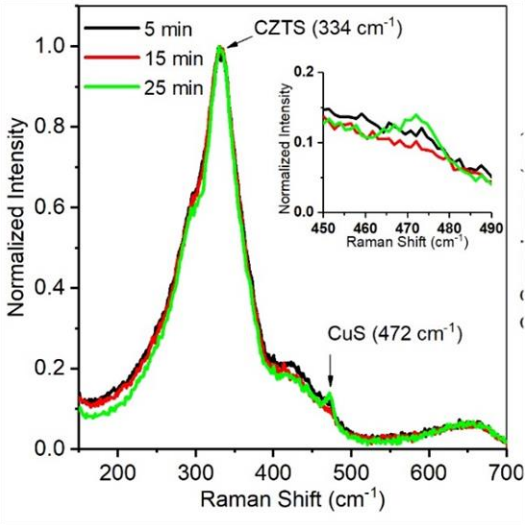
Project Summary

The need for high temperature processing has a significant negative effect on the Energy Pay-Back Time (EPBT) of photovoltaic materials, including copper-zinc-tin-sulfide (CZTS). We present the synthesis of CZTS nanoparticles (NPs) at room temperature and ink stabilization using small ions (e.g. S^{2-}/NH_4^+)*.

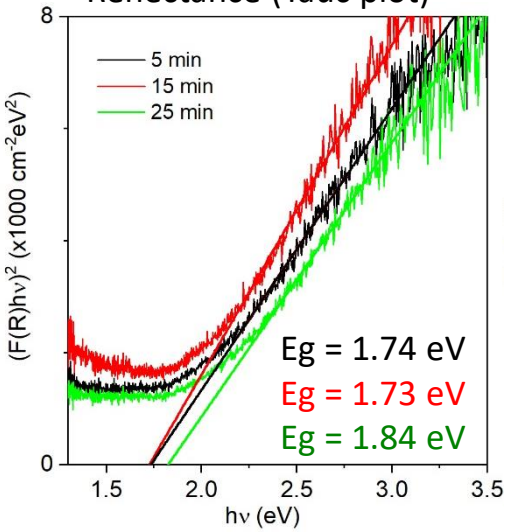
- Precursor 1: CuCl, $ZnCl_2$ and $SnCl_2$
- Precursor 2: NaSH (~30% excess)
- Reaction time (5-25 min) in N_2-filled glovebox.
- CZTS NP size: 6.15 ± 2.5 nm
- Cu_xS-formation threshold: Cu/Sn = 1.7



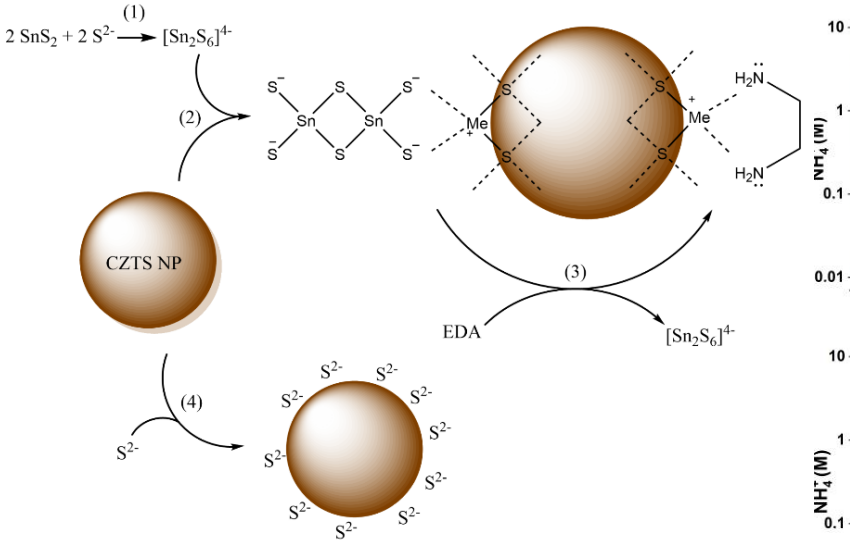
Raman Scattering (532 nm)



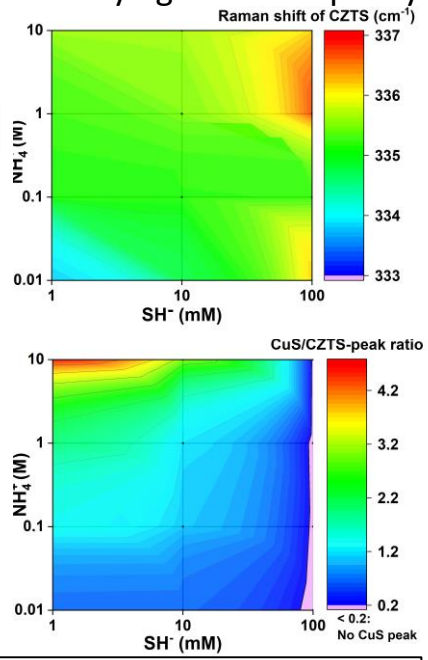
Reflectance (Tauc plot)



Thiostannate complex and sulphide ligands



NH_4^+/SH^- ligands: Modifying CZTS ink quality



Project Impact

Carbon-free Ink formulations:

- Thiostannate complexes (can be displaced by EDA).
- Ammonium (promotes CuS).
- Sulfides (reverse CuS formation).

Co-authors/institutions

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Professor Jens W. Andreasen, Department of Energy Conversion and Storage, DTU.

Stable, carbon-free inks of Cu2ZnSnS4 nanoparticles synthesized at room temperature designed for roll-to-roll fabrication of solar cell absorber layers
Journal of Alloys and Compounds 787 (2019) p63 (DOI: 10.1016/j.jallcom.2019.02.014)

*Derived from method previously described (G. Larramona, RSC Adv. 4 (2014), p14655).

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