Template free electrochemical deposition of tellurium nanowires from eutectic solvents

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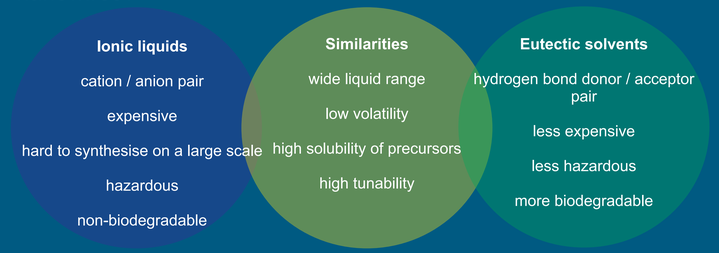
1. Introduction

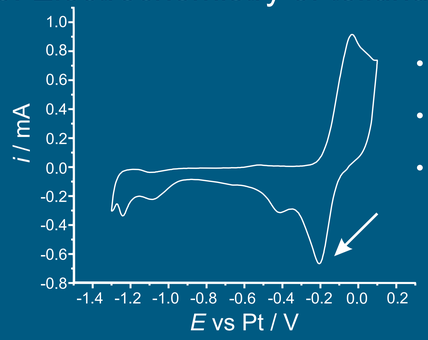
- Tellurium is an interesting material for thermoelectric application
- Nanostructures always outperform bulk materials
- Current methods are energetically expensive and complicated
- Can we use electrochemistry to make tellurium nanowires?

2. The concept

- Previous works made tellurium nanowires in ionic liquids by electrochemically reducing Te^{4+} at an electrode with a liquid template
- Worked well, but ionic liquids have a number of challenges
- Eutectic solvents can solve these challenges, but can they still make nanowires?

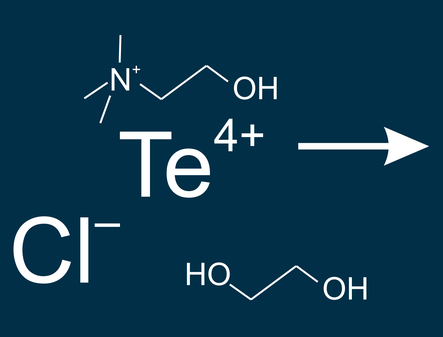


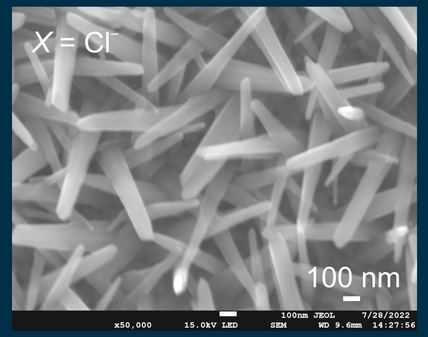
3. Electrochemistry of tellurium in eutectic solvent

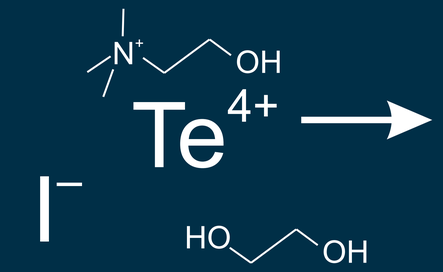


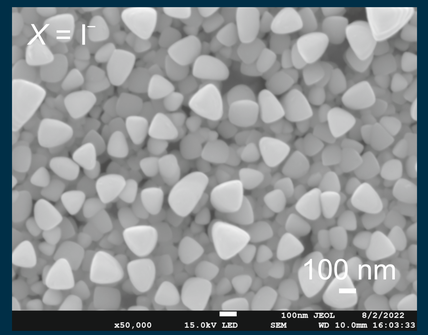
- Cyclic voltammetry of $TeCl_4$ in eutectic solvent
- Solvent made of 1:2 choline chloride : ethylene glycol
- Peak with arrow shows the deposition potential

Choosing the correct eutectic solvent allows us to make either nanowires or nanoplatelets of tellurium without needing a template





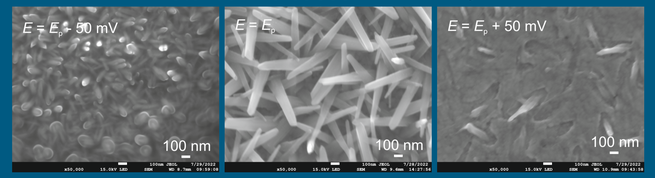




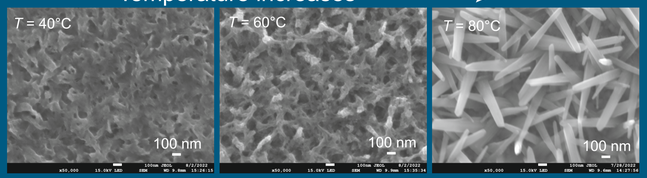
4. Producing nanowires

- Surprisingly, deposition produced tellurium nanowires without needing a template
- Making wires was *very* dependent on the reaction conditions

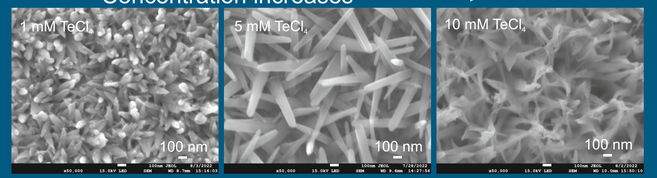
Potential increases →



Temperature increases →



Concentration increases →



5. Halides control the nanostructure

- Chloride ions gave wires but iodide wires gave platelets (center)
- Bromide ions gave no nanostructure at all
- Halides appear to control the nanostructure for tellurium