Bulk and Thin-Film Single Crystal Growth of Next-Generation Superhard, Electronic & Optical Materials

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**Solvothermal Methods**

**Ammonothermal Method**

- < 300 MPa | < 1000 °C | supercritical NH₃ solvent
- Due to use of ammonia as a solvent, we can synthesize nitrogen-containing materials (nitriles, carbonitriles, oxynitriles, etc.) under relatively mild thermodynamic or kinetically-limited conditions to sizes < 1 inch

**MATS Facilities & Autoclaves**

- > 6 autoclaves in parallel | 2 independent setups | 1” inner diameter autoclaves
- Our crystal growth facility is unique in the world due to our ability to pursue ammono-thermal single crystal growth in novel, extremely corrosion resistant Mo-alloy, in traditional NiCr superalloys (right) or SS autoclaves.
- Operations require an oxygen-free environment and hence use of hermetically sealed, inert atmosphere, 1-inch thick steel-lined containment vessels is mandated (left).

**Materials:** e.g. cubic BN
- Ultra-hard | ultra-high thermal conductivity | superior electronic properties

**Vision**

- Novel equipment development | crystallographic materials | nitrides & related materials | (ultra) wide bandgap semiconductor
- We are vertically integrated, allowing us to develop next-gen devices on tailored substrates in innovative growth systems

**Flux Methods**

**Alkali metal Fluxes**

- < 10 MPa | < 1200 °C | non-toxic | high nitrogen solubility

**Materials:** e.g. Ternary Nitrides
- Unexplored & new material systems | fundamental science | 477 table ternary nitrides predicted, only 218 demonstrated to-date. Requires new approach to synthesize.