

Mixed Metal Alkoxide Precursors for Direct Write of Complex Ceramic Oxide N-inks

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Summer Project Focused on Synthesizing Ceramic Inks for Aerosol Jet 3D Printing

Goal:

3D print complex materials in complex architectures

Motivation:

Most 3D inks are plastic based, not ceramic

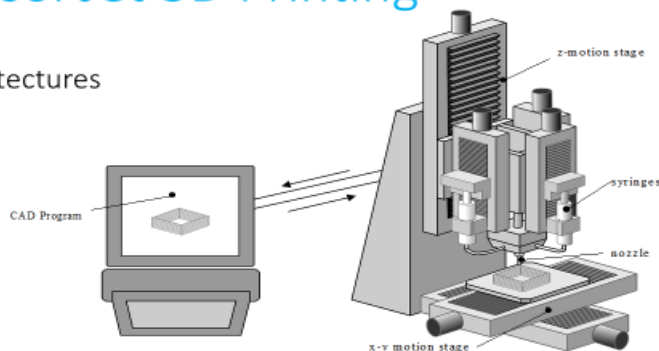
Background:

Ink Jet: Propels droplets of ink

Gravure: Scaled up printing. 2D

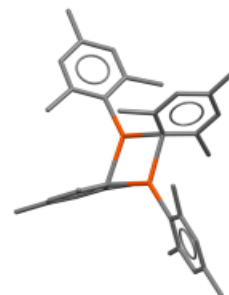
Extrusion Casting: Thick colloid suspension

Aerosol Jet: Colloid suspension in air that can produce fine 3D prints

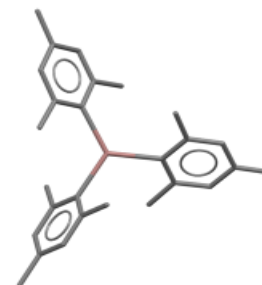


Synthesis of the Precursors Focused Mainly on Group 13 Alkyls

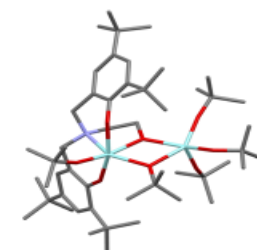
- Reactions were done on both dimers and monomers
- Titanium and zirconium were the most common
- Reacted with mostly group 13 alkyls
- Also reacted with first row transition metal alkyls



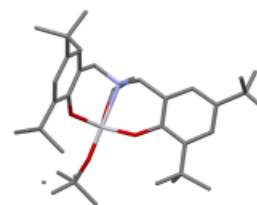
Iron Mesityl



Indium Mesityl

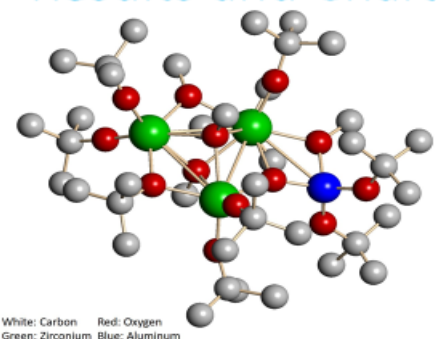


Metal Dimer (M = Ti, Zr, Hf)



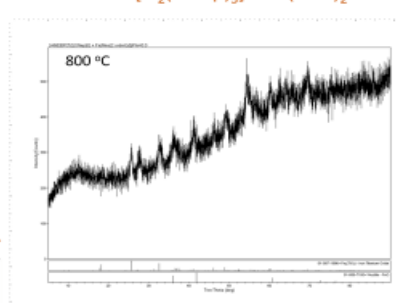
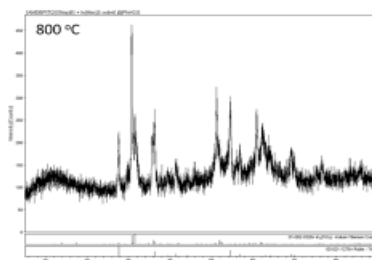
Titanium Monomer

Results and Characterizations of Synthesized Mixed Metals

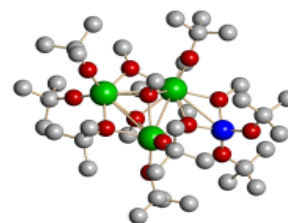


Crystal Structure of AMDBP[Zr₂(OBu^t)₅] + Al(Me)₃. Crystal shows that a mixed metal was synthesized, however the AM-DBP₂ ligand was lost

PXRD spectrum of AMDBP[Ti₂(ONep)₅] + In(Mes)₃. Spectrum matches peaks seen in Indium Titanium Oxide



PXRD spectrum of AMDBP[Ti₂(ONep)₅] + Fe(Mes)₂. Spectrum matches the peaks seen in Iron Titanium Oxide



Conclusions

- Mixed metal complexes attempts
 - AMDBP[Ti₂(ONep)₅] + Fe(Mes)₂
 - AMDBP[Ti₂(ONep)₅] + In(Mes)₃
- One mixed metal that lost H₃-AM-DBP₂ ligand
 - AMDBP[Zr₂(OBu^t)₅] + Al(Me)₃
- H₃-AM-DBP₂ ligand is necessary in order to synthesize mixed metals
- Unsure of the effect of H₃-AM-DBP₂ on nanoparticle synthesis

