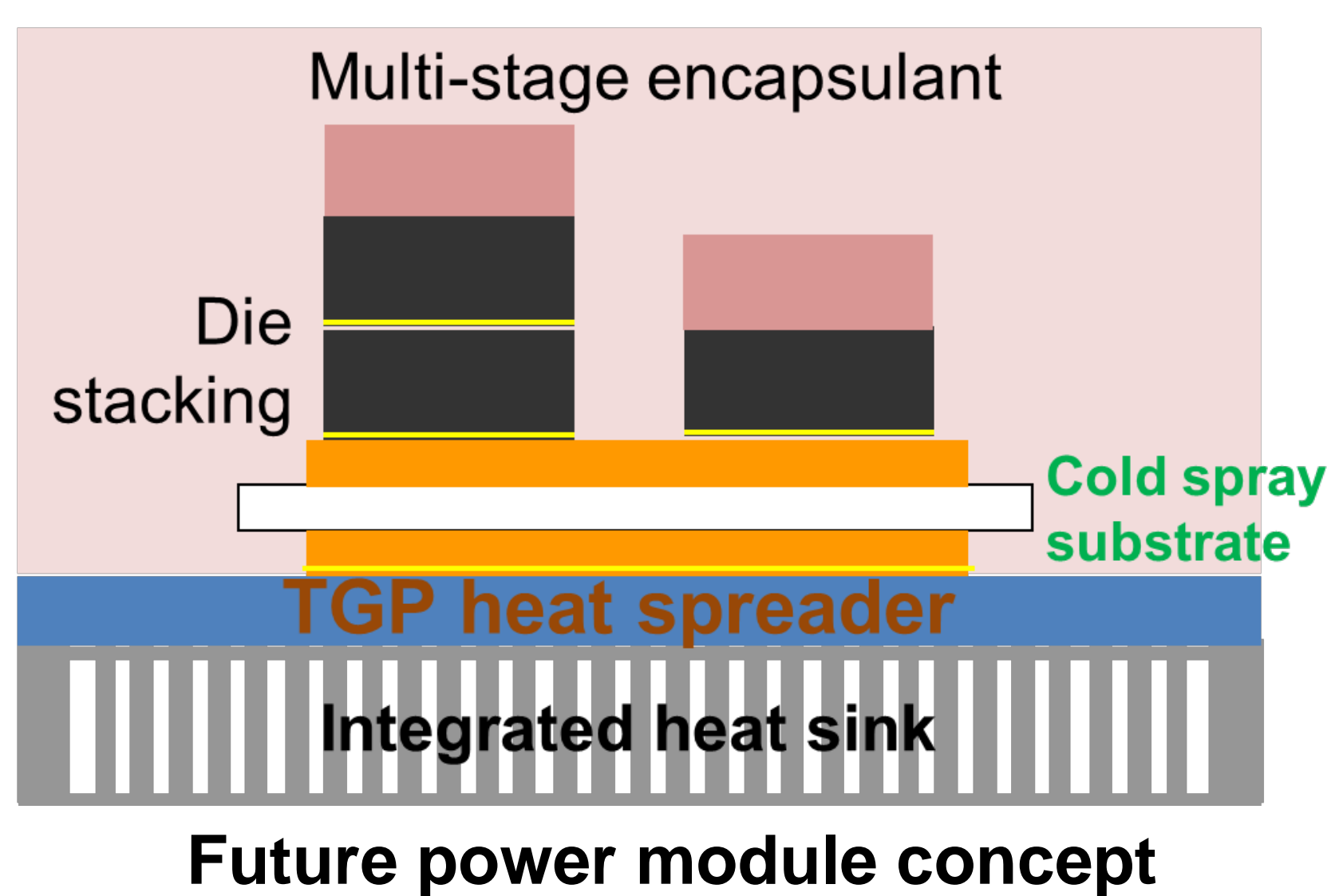


S&T Campaign: Sciences for Maneuver  
*Energy & Propulsion*  
*Power Energy Conversion*

Dimeji Ibitayo  
(301) 394-5514  
oladimeji.o.ibitayo.civ@mail.mil

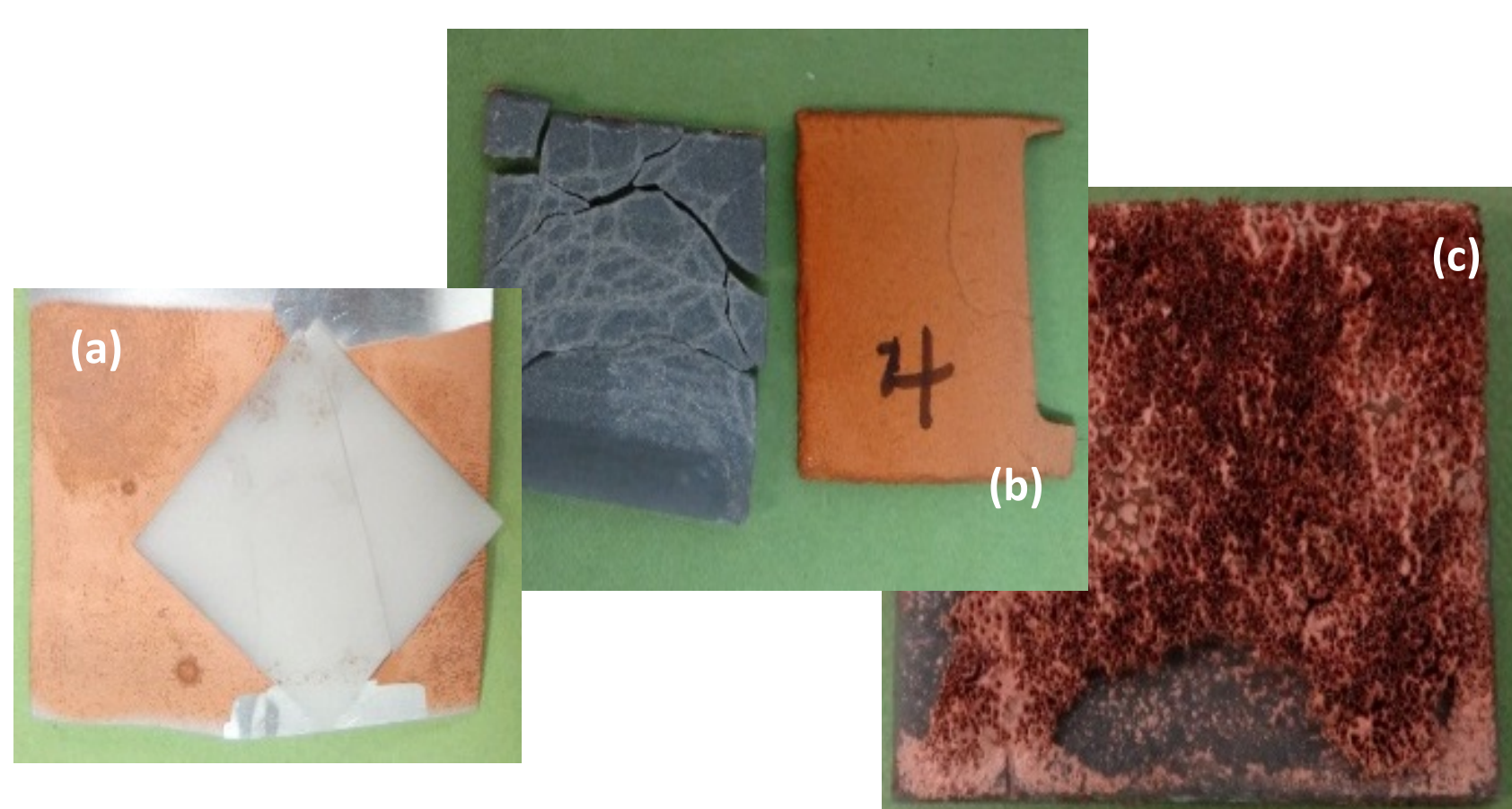
## Research Objective

- Develop advanced additive manufacturing materials and processes to enable low quantity and low cost production of improved SWaP-C power packaging.
- Advance power packaging for high voltage operation (>20 kV), increased power density (>500 W/cm<sup>2</sup>), reduced inductance, thermal transient suppression, and increased reliability.



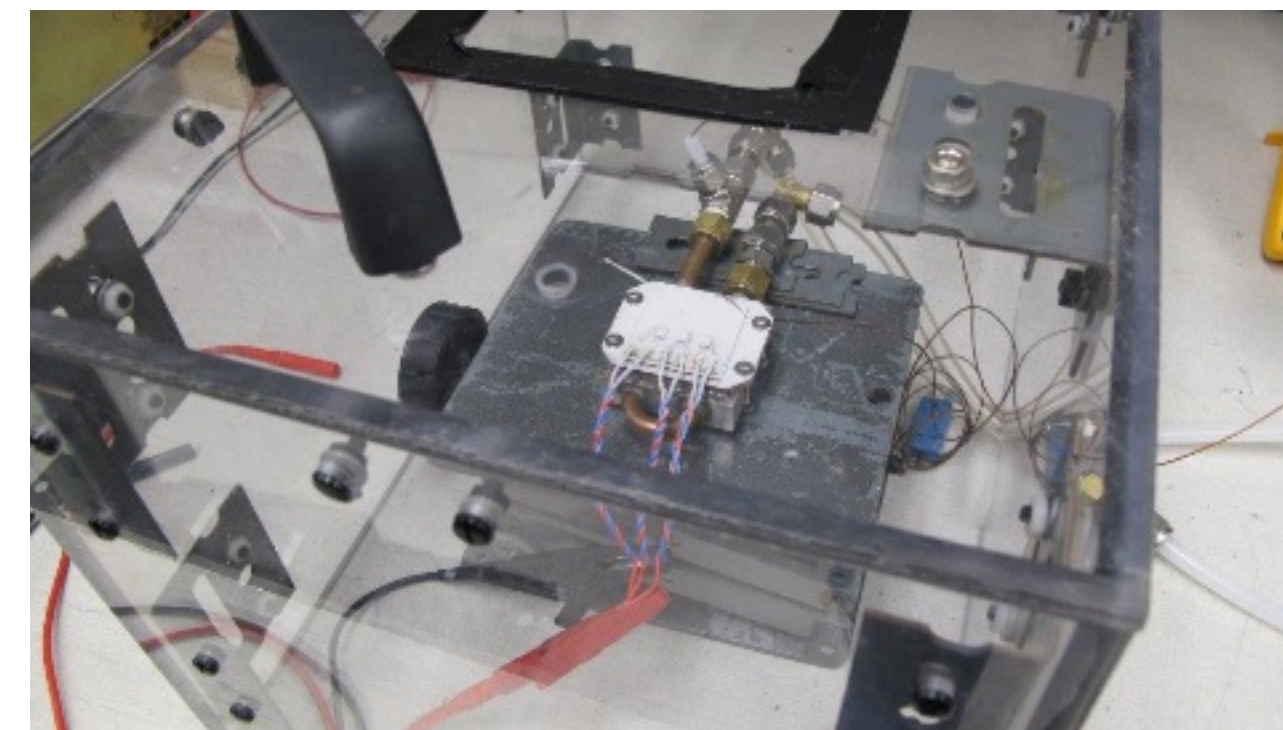
## Challenges

- Materials applied through additive manufacturing methods that achieve near bulk performance.
- Integrated function packaging components (power substrate, heat spreader, heatsink, control circuitry, etc.)
- Direct adhesion between dissimilar materials with minimal thermal resistance



Previous results of Cu-on-AlN – (a) non-adhesion, (b) substrate damage and delamination, (c) porous, sponge-like deposit

## ARL Facilities and Capabilities Available to Support Collaborative Research



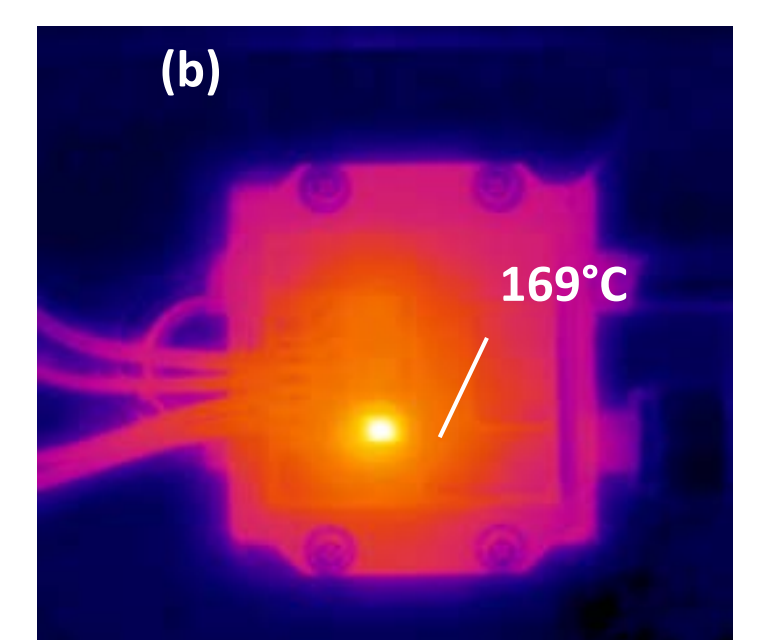
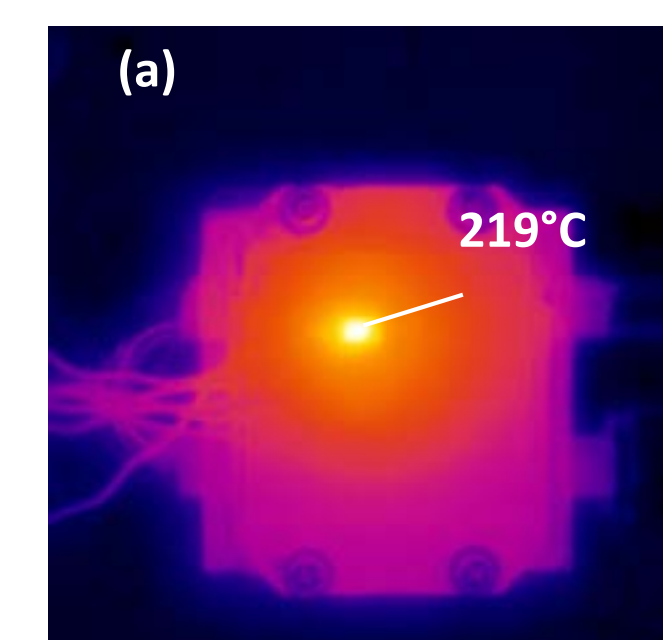
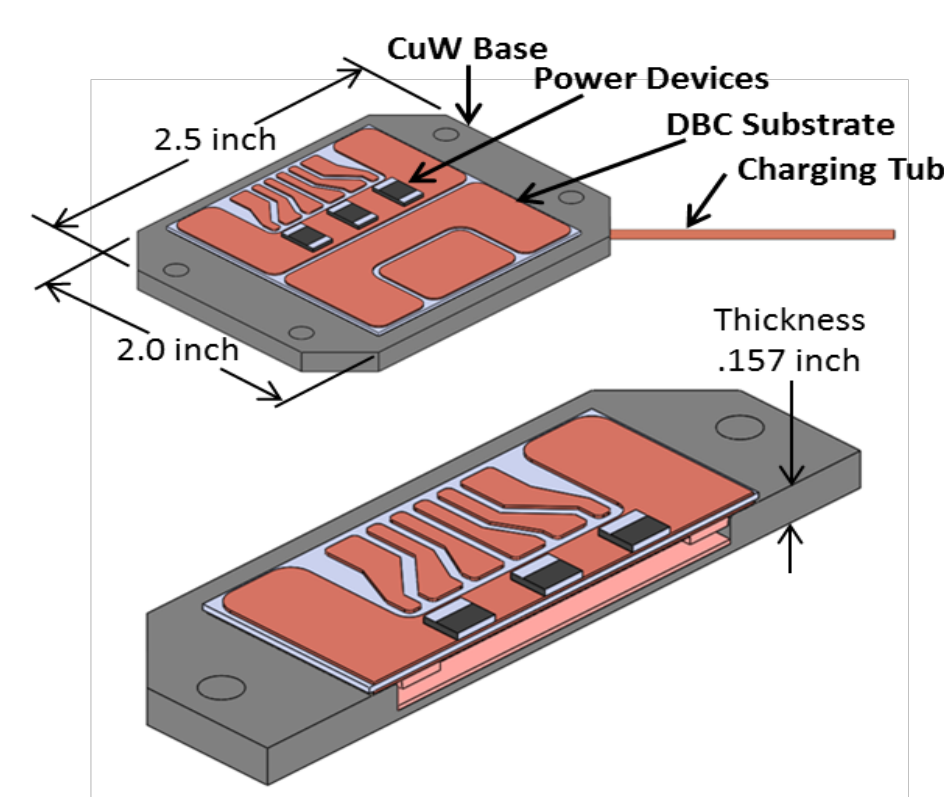
ARL Power Packaging & Testing Facility



ARL Center for Cold Spray

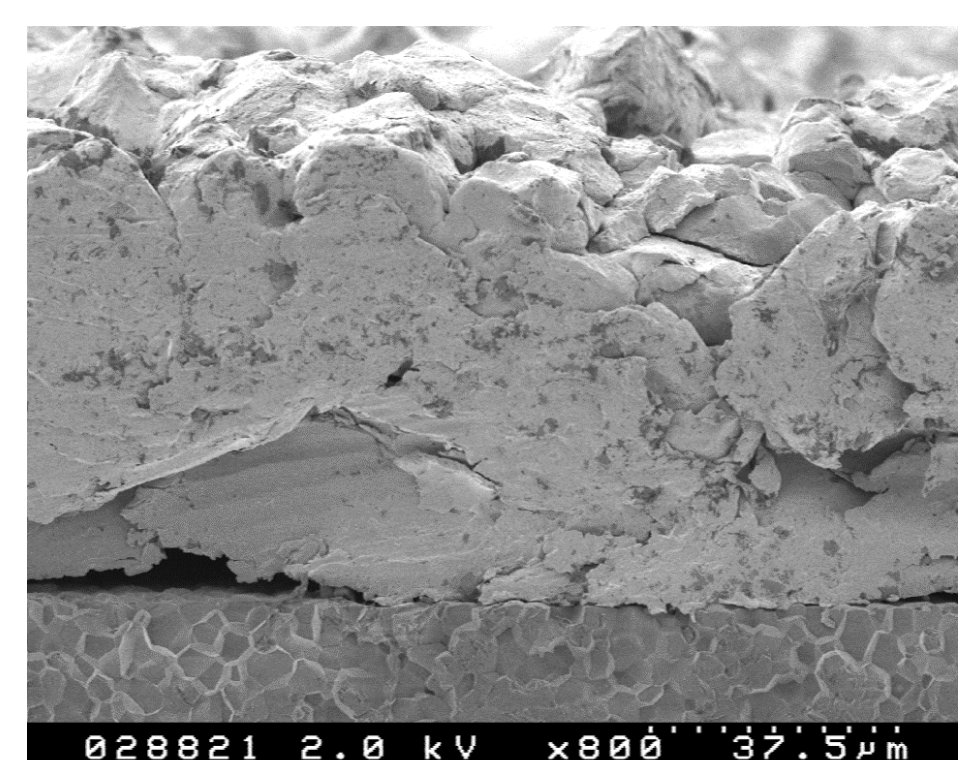
### Preliminary results

#### 1) Vapor chamber/TGP heat spreaders

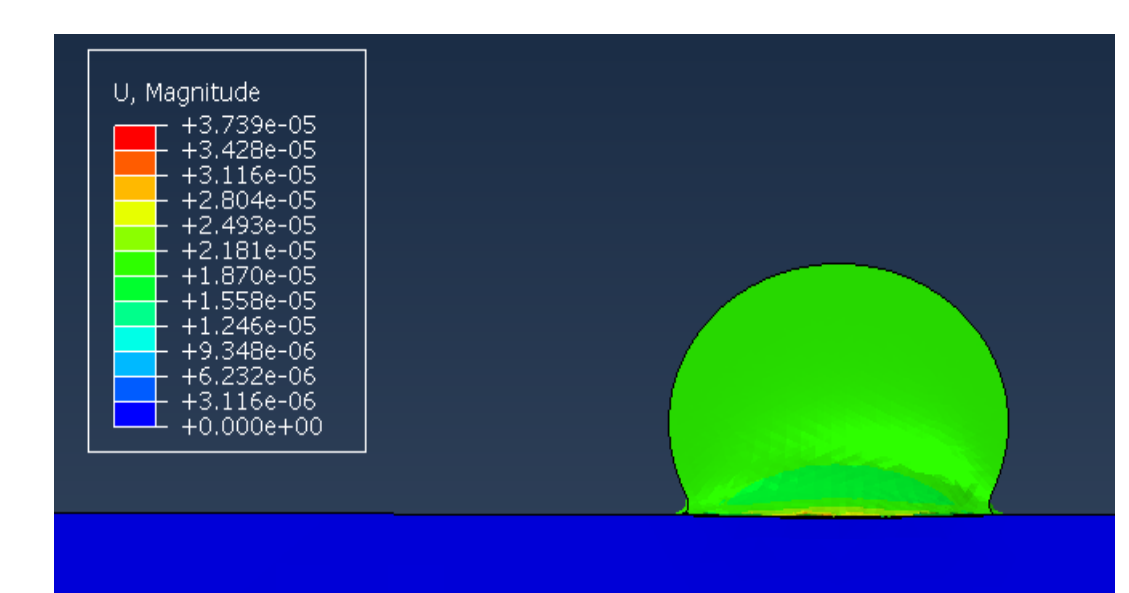


(a) Solid CuMo, (b) vapor chamber heating at 520 W/cm<sup>2</sup>

#### 2) Cold spray power substrates



Surface treatments (i.e. oxidation and grit blasting) promoting adhesion



Metal on ceramic: single particle impact

## Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Power module development using additive manufacturing of metals (copper and others), ceramics, and polymers for thermal, structural, and electrical packaging elements
- Control circuitry integration using additive manufacturing
- Wirebondless packaging