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# Thermal Transport in Reactive Metal Multilayers

## Influence of Periodicity and Interfacial Mixing

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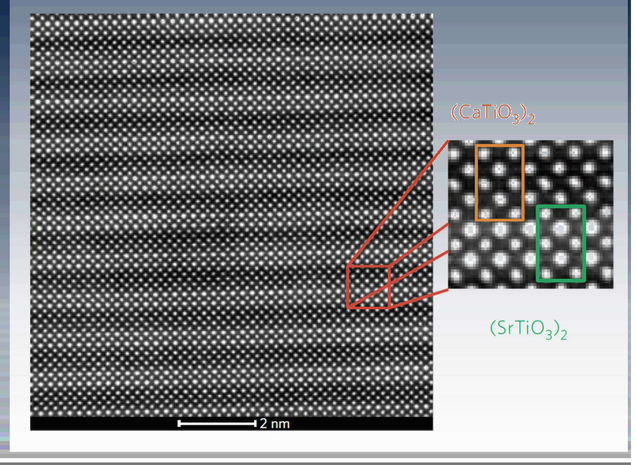
**Need:** Reactive metal multilayers for: joining, bonding, ignition, and power.

**Problem:** Thermal properties dictate performance. Few measurements & incomplete understanding of transport.

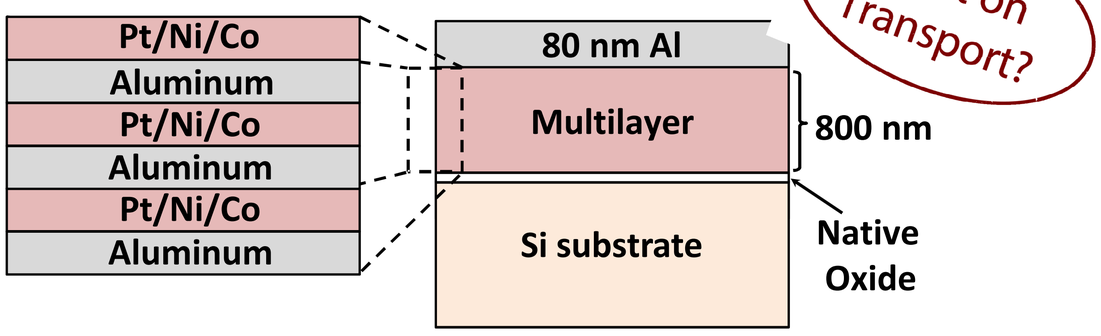
**Premise:** Thermal resistance can DECREASE with more interfaces in non-metals. How about in metal multilayers?



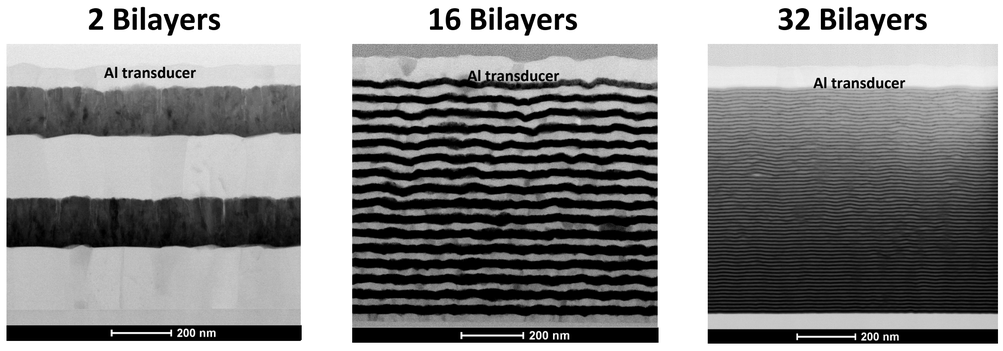

## Designer Interfaces

**Metal multilayers (800 nm) fabricated with varying:**
**composition, interface number, and intermixing.**

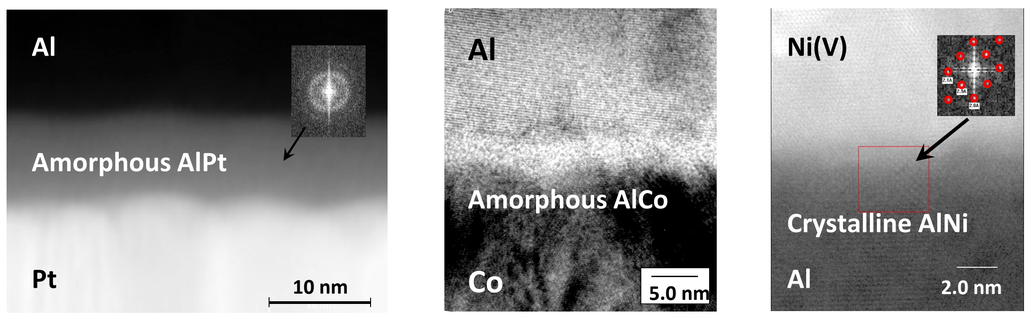
### Composition: Al->Pt, Co, or Ni




### Number of Interfaces




### Intermixing



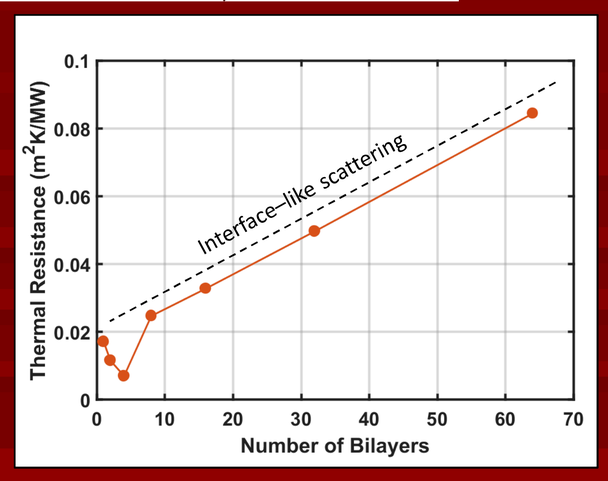

## Interfacial to Amorphous Transport

*Question:* Is thermal resistance just the sum of resistances from each interface and the bulk materials?

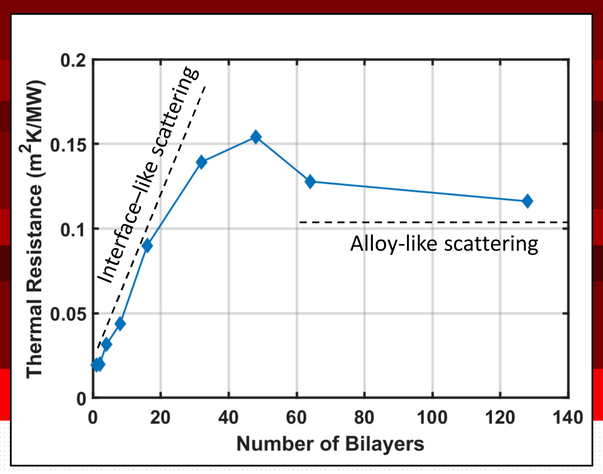
$$R_{Tot}(n) = R_{Mat,1} + R_{Mat,2} + nR_{Int}$$

### Al/Co: Thin Amorphous

*Takeaway:* Linear resistance trend. Implies interface dominated scattering



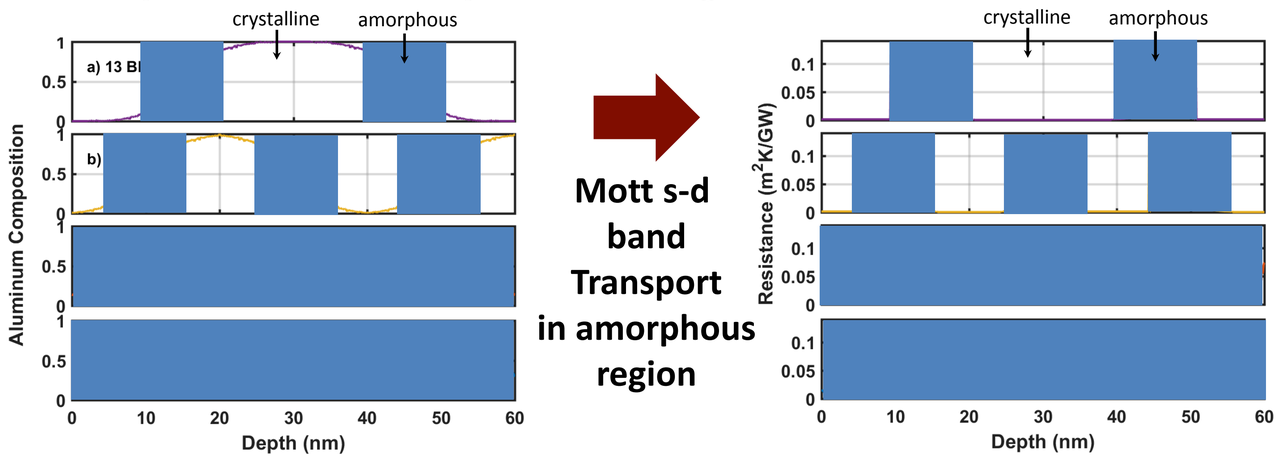

*Question:* Does interface mixing impact thermal transport?




### Al/Pt: Thick Amorphous

*Takeaway:* More interfaces lead to lower thermal resistance. ***WHY?***

*Takeaway:* d-band dominated electron transport in Pt-rich amorphous Al/Pt alloy creates large interface-like resistance.




## Take Home Message

### Boundaries can help thermal transport

- Pt-rich amorphous region creates high—interface like—resistance due to d-band electronic transport.
- Reduced Pt-rich regions when interfaces blend together
- Intermixing removes ”largest constraint” improving transport even with more boundaries.

**Disorder can be leveraged to improve thermal transport in metal multilayers**

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