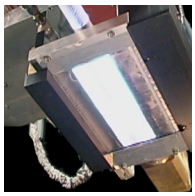
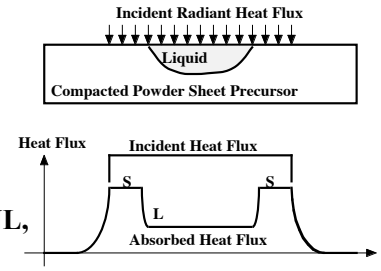
# Infrared Processing using High Density Plasma Arc Lamp



Vortek Plasma Arc Lamp - ORNL, Materials Processing Group

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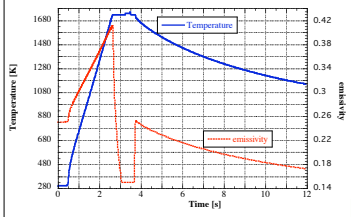
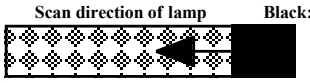
Adrian S. Sabau (sabaua@ornl.gov), Numerical simulation of the IR process

# After Considering Emissivity Variation With Surface Condition in the IR Process, Solidification Patterns Have Been Predicted

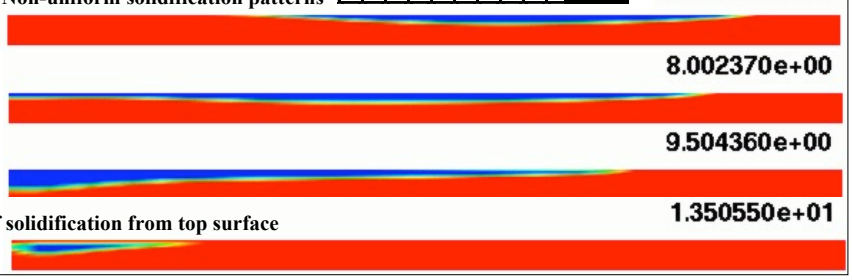



Emissivity varies with surface condition (powder compact, liquid, bulk solid after solidification).

Liquid pool (blue) evolution during IR processing for a 10 cm long Nickel sheet.

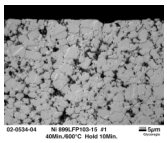



Non-uniform solidification patterns

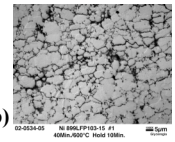



Onset of solidification from top surface

# Surface Morphology of Powder Compact Changes Due to Sintering Effects During IR Processing

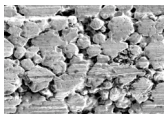


(a)

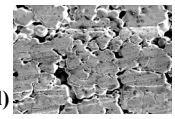


(b)

Microstructure in vertical cross sections (a) near the surface and (b) in the center.



(c)



(d)

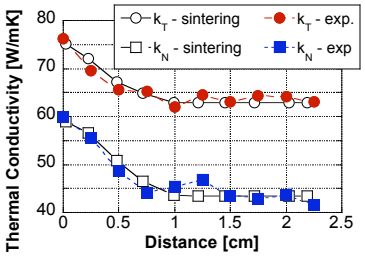
SEM Micrographs of the surface (c) unprocessed and (d) IR processed.

There is more contact between particles near the surface. In the center, the particles are well delineated showing a poor contact.

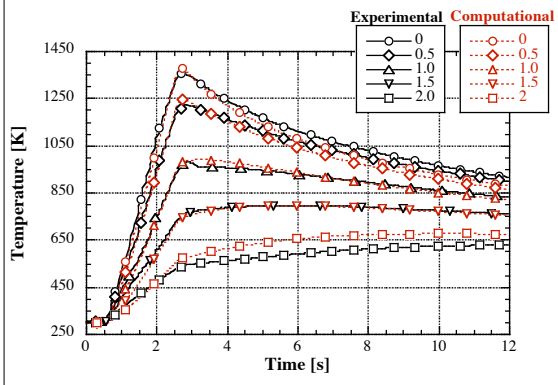
After thermal processing, the particles are well bonded due to sintering effects (Fig. d).

Thermal conductivity is affected by sintering effects.

A thermal conductivity (k) model was developed to account for sintering effects based on activation energy processes. Excellent agreement was obtained for thermal conductivity variation during IR processing in the normal and transversal directions.



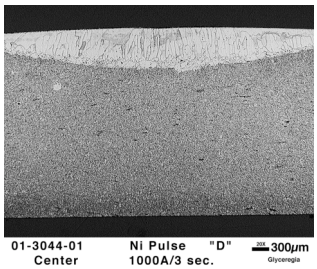

# Temperature Evolution Was Accurately Predicted for the IR Processing of Thin Gauge Ni Sheet




Temperature results for two second IR pulse of powder compact Ni sheet.

Ni sheet dimensions: 10x4.8x0.32 cm

Processed Area




Liquid pool for three second IR pulse.