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Photos placed in horizontal position with even amount of white space between photos and header

Diffusion bonding of Cu to Nb

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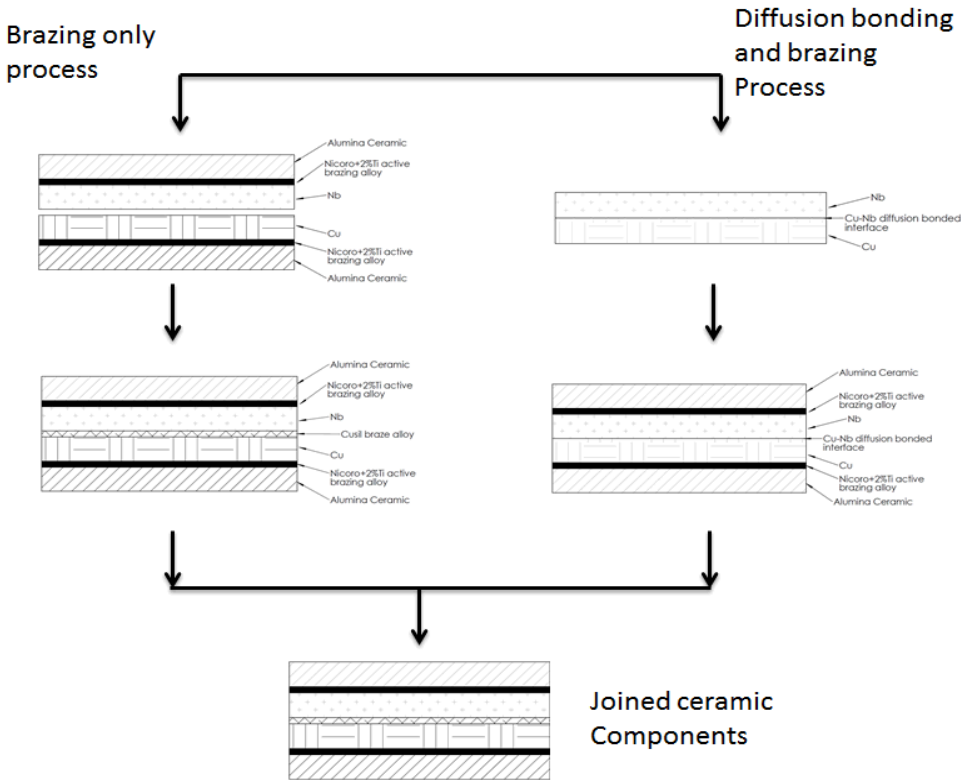
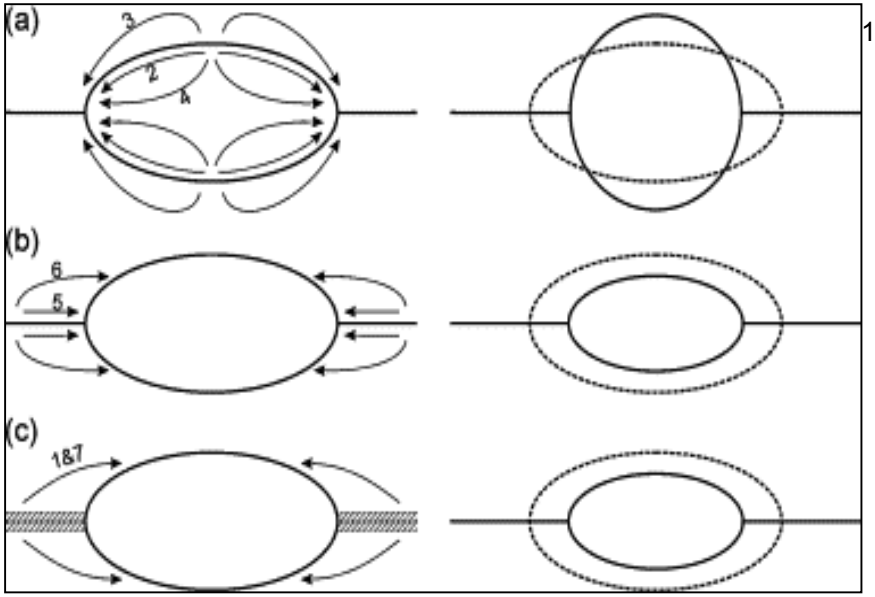
Introduction

- Join two ceramic components
- Current method multiple braze cycles
  - Alumina to Nb, Cu to Nb
- Goal: Join two ceramic components with optimized diffusion bonded Cu-Nb substrates



Diffusion bonding

- Solid state joining of similar or dissimilar components
- 2 sets of mechanisms during diffusion bonding
  - Deformation mechanisms
  - Diffusion mechanisms

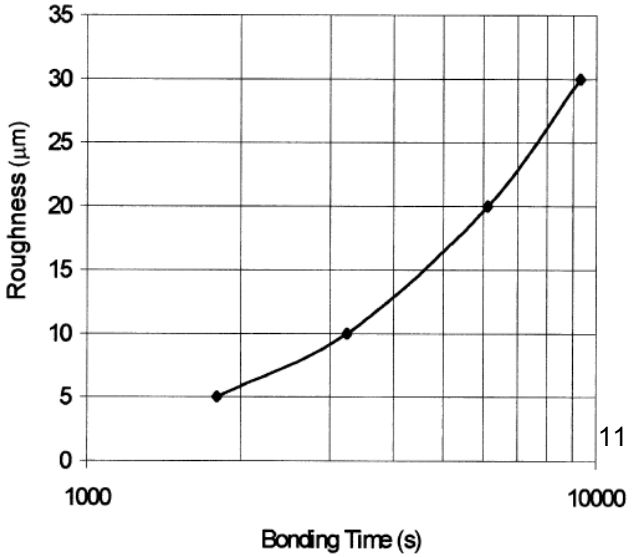


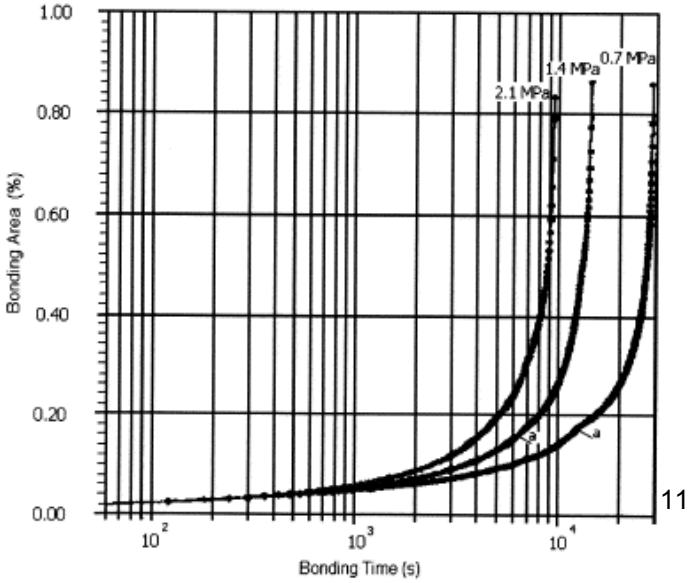
Literature review

- Diffusion bonding of Cu to Nb research is insufficient
- Research has been conducted on:
  - Cu-W with bond aid[1,2]
  - Cu-Alumina[3,4,5,6,7]
  - Nb-Alumina[3]
  - Cu to 304L stainless steel[8]

Diffusion bonding parameters

- Surface preparation
  - Surface roughness
  - Cleanliness
- Temperature
- Pressure
- Time

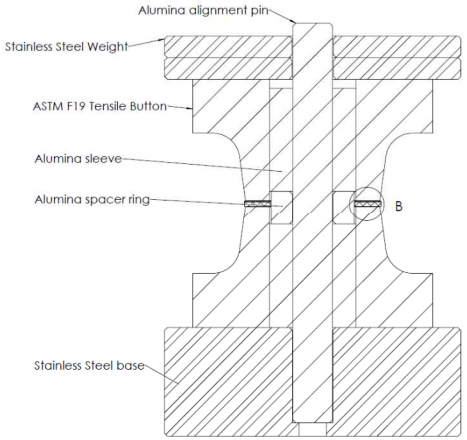


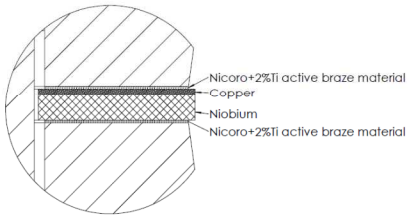


Characterization

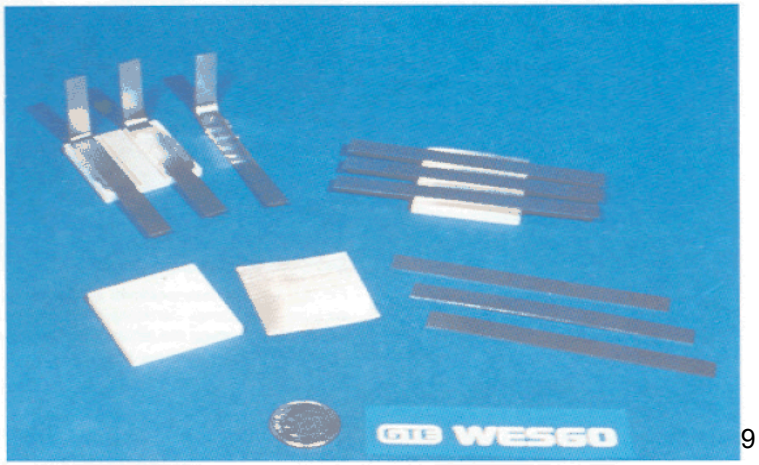
- Braze samples with Nicoro™+2%Ti
- Helium leak check with

  He mass spec leak detector
- SEM
- Mechanical testing
  - Peel test: bonded interface
  - Tensile test: braze joint





DETAIL B
SCALE 30 : 1



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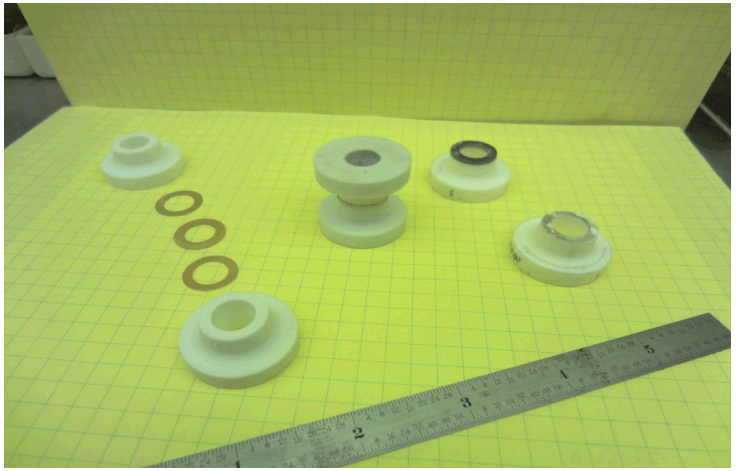
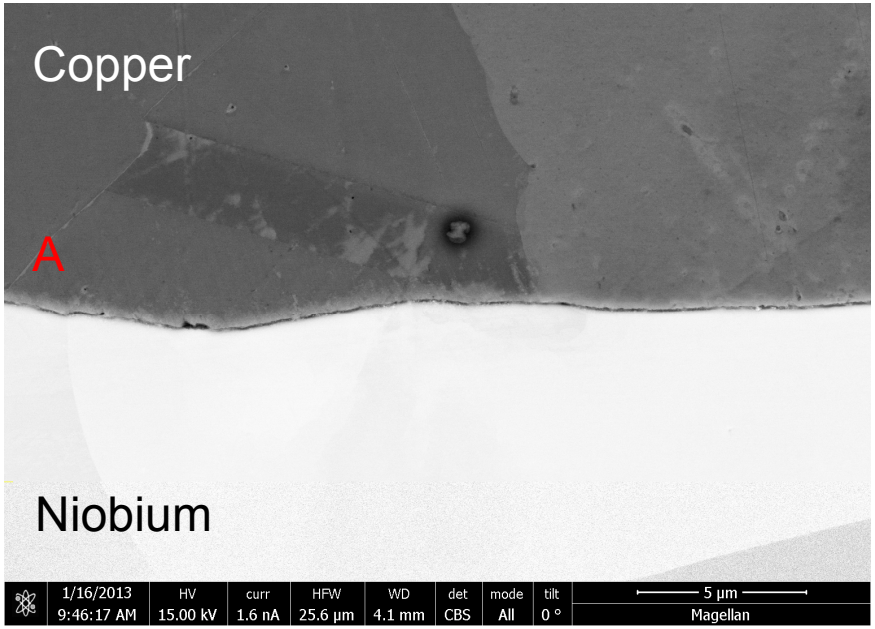
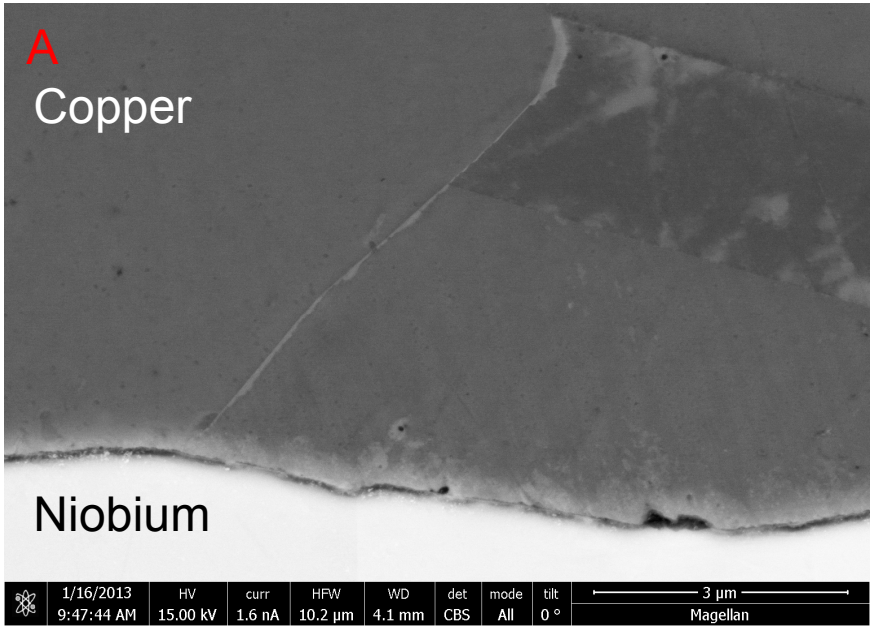


Results

- Cu-Nb bonded interface.
- Bonding parameters: 1035°C, 3 hours, 4MPa (0.6 KSI)





Results

- Tensile button test
  - Diffusion bonding parameters: 1035°C, 3 hours, 4MPa (0.6 KSI)

Sample	Leak rate [sccs]		Load [lbs]	KSI*	MPa		Failure Location
1	NDL		1602.40	8.91	61.42		Ceramic on Nb side
2	NDL		2797.00	15.55	107.21		Ceramic on Cu side
3	NDL		2142.10	11.91	82.11		Ceramic on Cu side

Avg.:	12.12	83.58

*: surface area=0.179873 in^2

Future experiments

- 5 initial experiments
  - 950°C, 1.2 KSI, 0.5 hours
  - 1050°C, 0.6KSI, 3 hours
  - 1000°C, 0.9 KSI, 1.75 hours
  - 1050°C, 1.2 KSI, 0.5 hours
  - 950°C, 0.6 KSI, 3 hours
- 3 additional experiments to dial in optimal parameters
- 2 final experiments to confirm optimal parameters

Questions and Comments

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