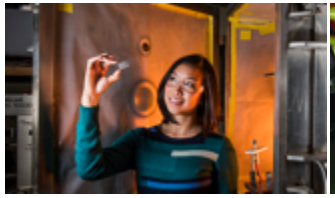
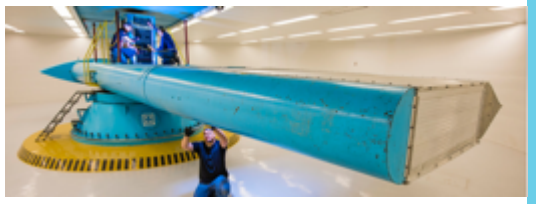
SAND2018-11390C

Microstructural characterization of Ag-Cu-Zr active braze alloy at varying temperatures





Emily Hopkins, Brittany Muntifering, Sandra Stangebye, Cory Gibson, Caitlyn Taylor, Daniel Berg, Raj Tandon

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Outline

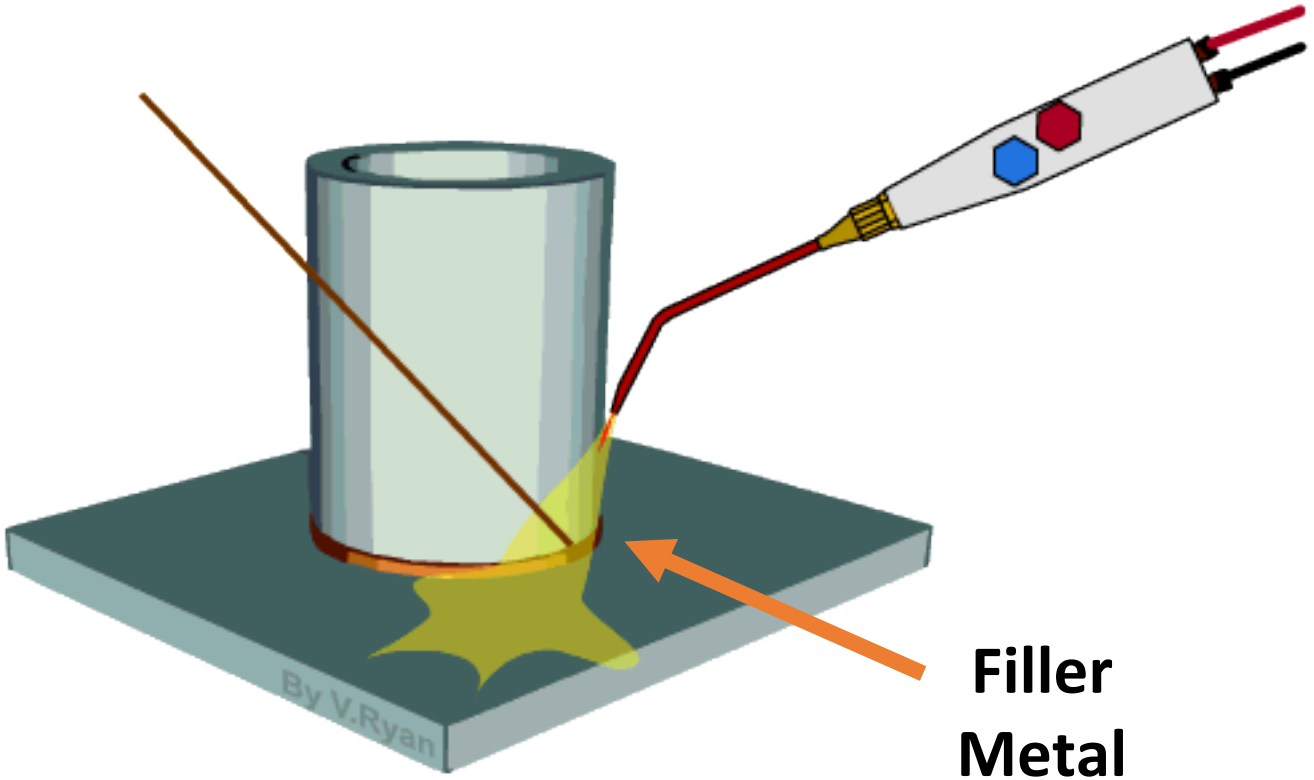
I. Introduction
   I. Common Joining Methods
   II. Brazing
II. Methods
   I. Furnace Brazing
   II. Conventional vs. Active Brazing
III. Objectives
   I. Braze Requirements
   II. Data Collection
IV. Experimental Results
V. Conclusion
VI. Future Work

Welding

Soldering

Brazing

What is Brazing?



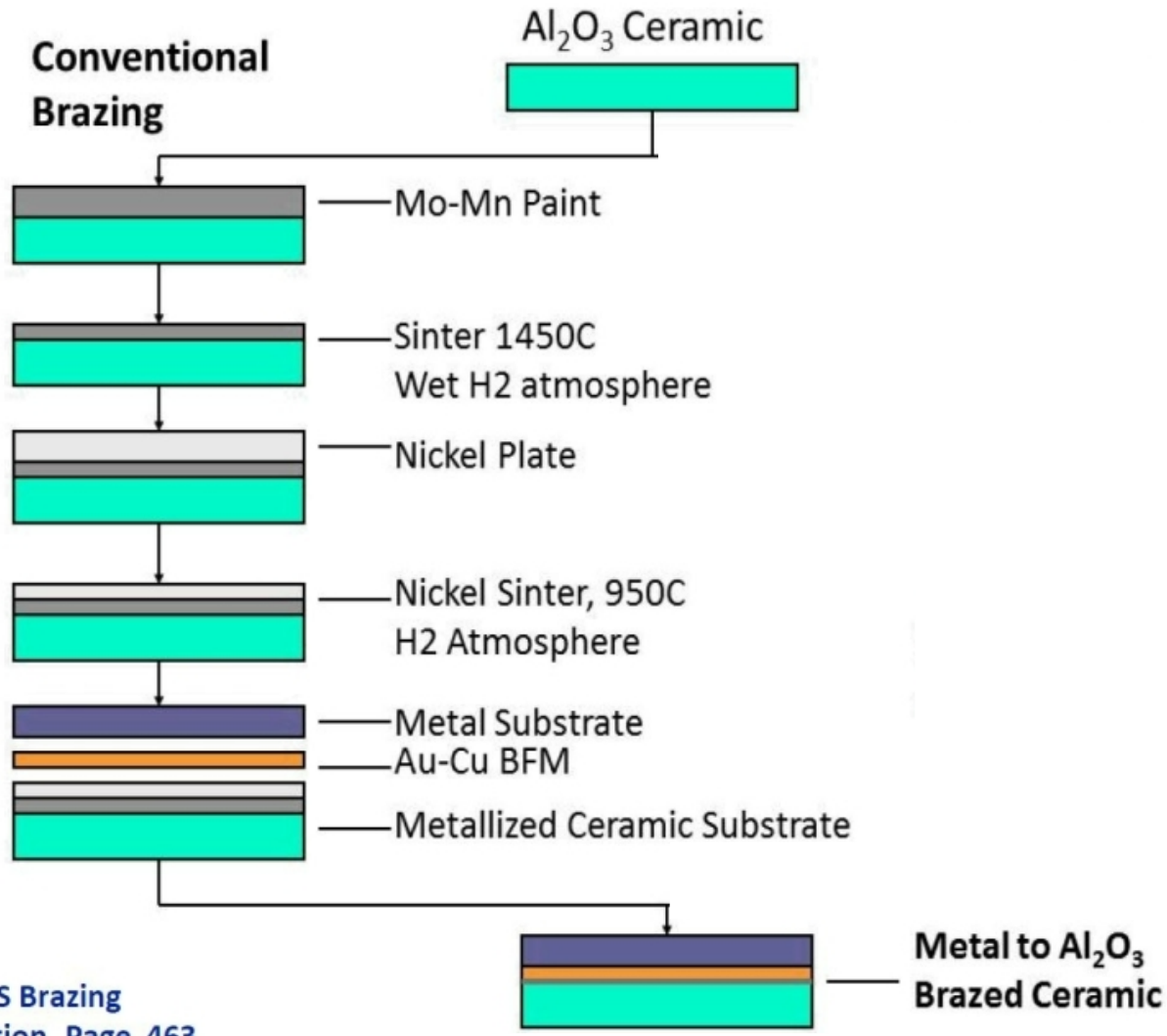
Furnace Brazing

Stack-Up

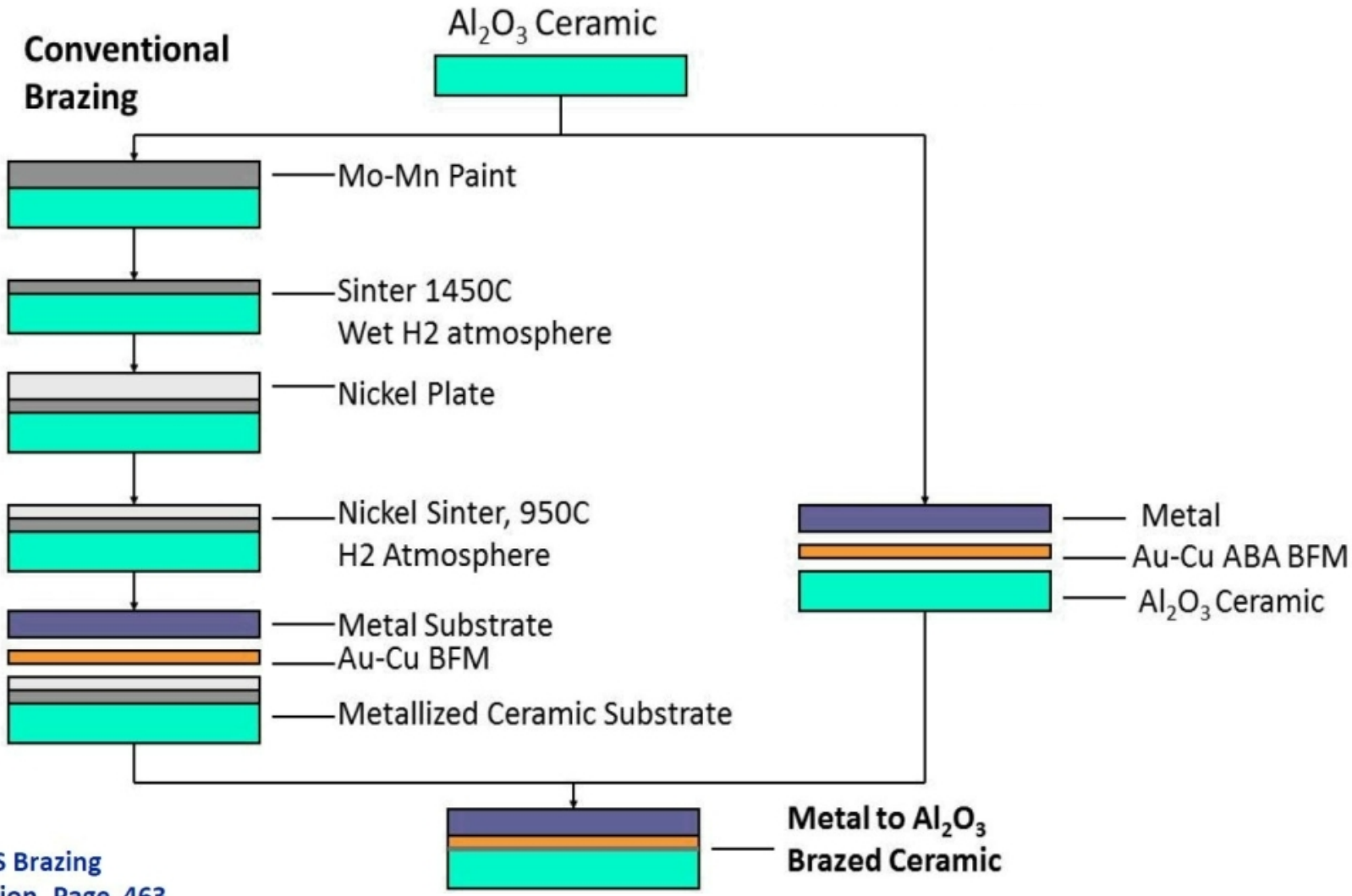
- Part
- Braze
- Part

Ceramics

- Manufactured from powders/formed into shape
- Advantages
  - Great strength, hardness, high wear resistance, corrosion and oxidation resistance, low thermal expansion, high electrical resistivity
- Challenges of wetting and flowing
- Active brazing promotes wetting on ceramics

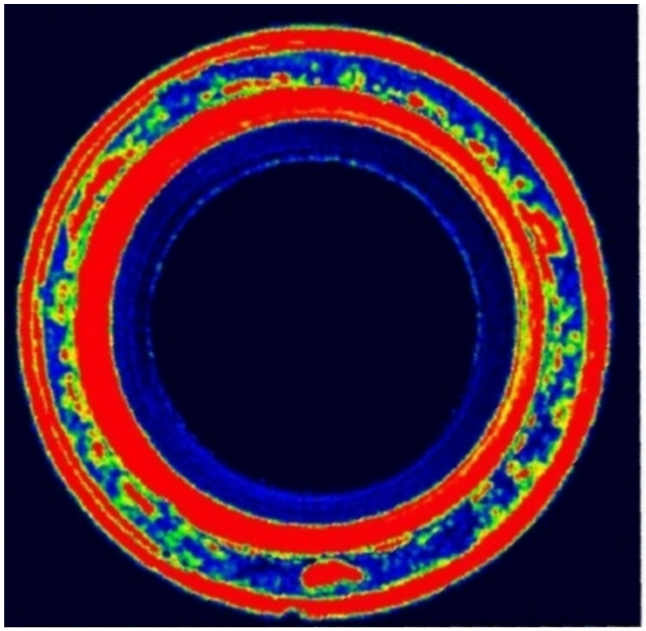


Adapted from AWS Brazing Handbook, 5th Edition, Page 463



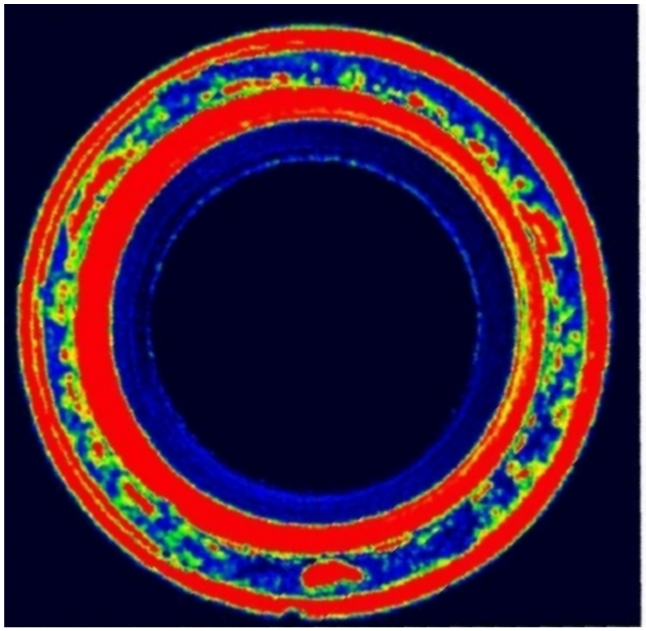
Adapted from AWS Brazing Handbook, 5th Edition, Page 463

Braze Requirements



Hermetic

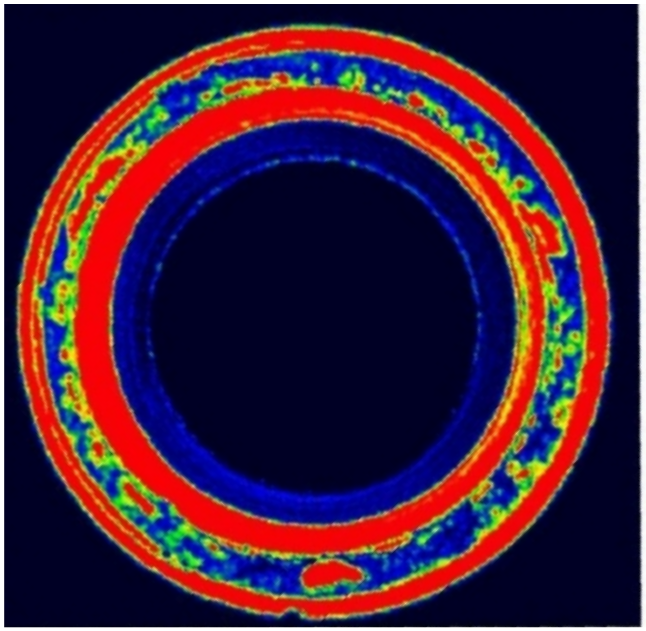
Braze Requirements



Hermetic

Strong

Braze Requirements



Hermetic

Strong

No Runout or Underfill

P

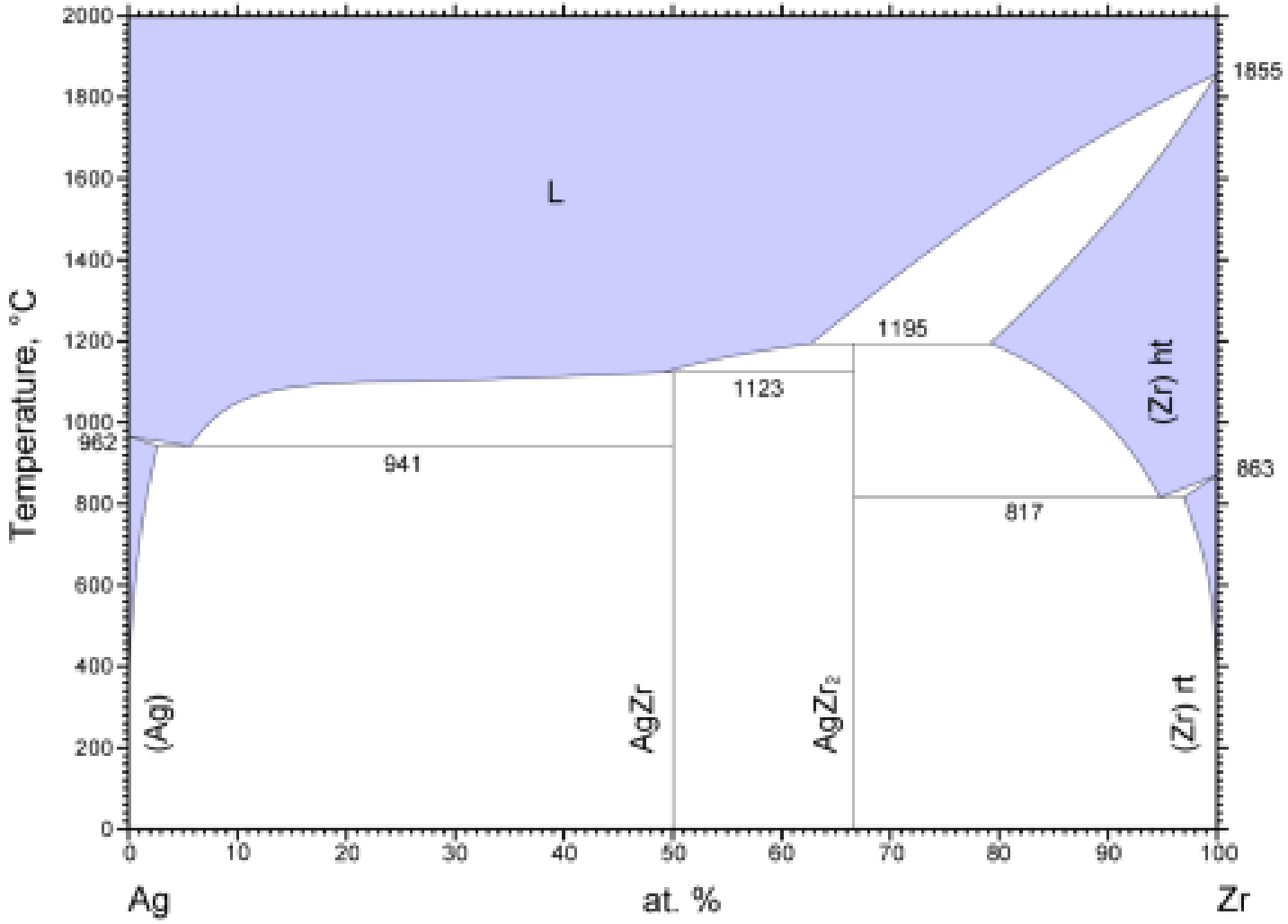
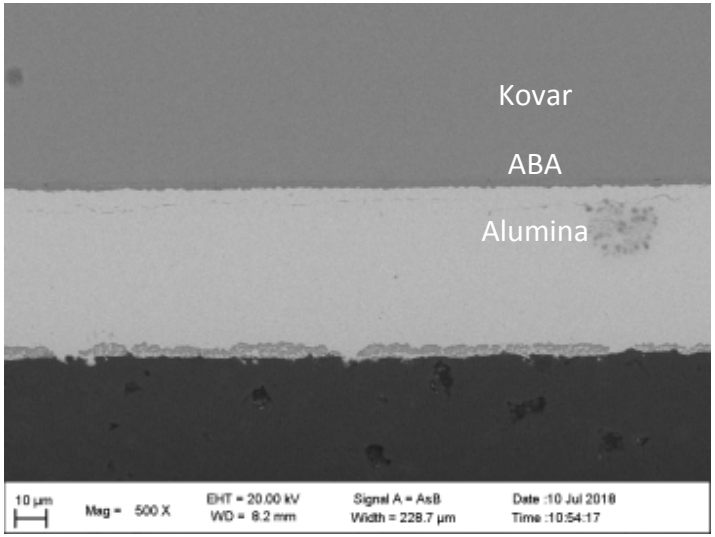
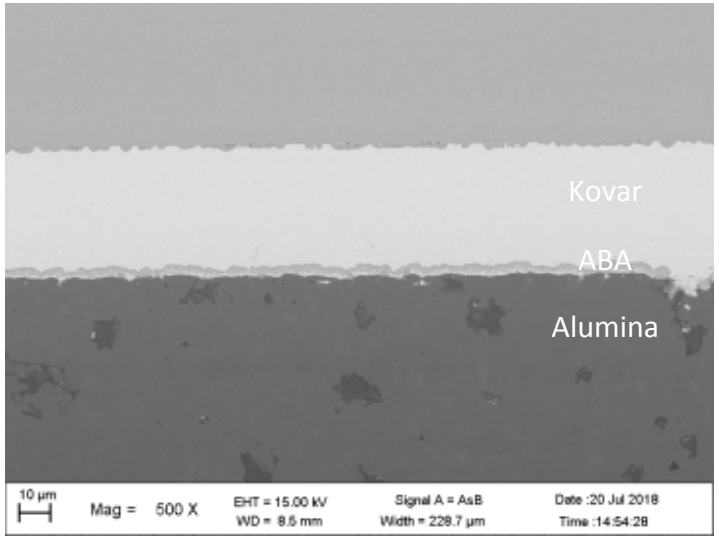


 Diagram No. 101013

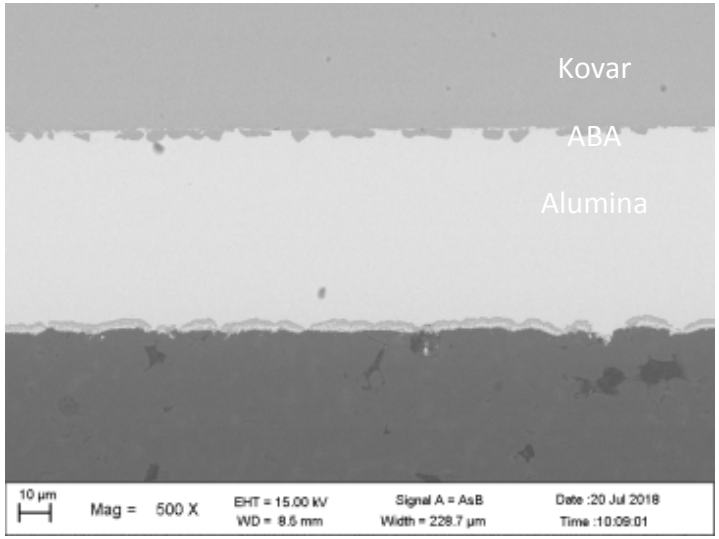
940°C



960°C



980°C

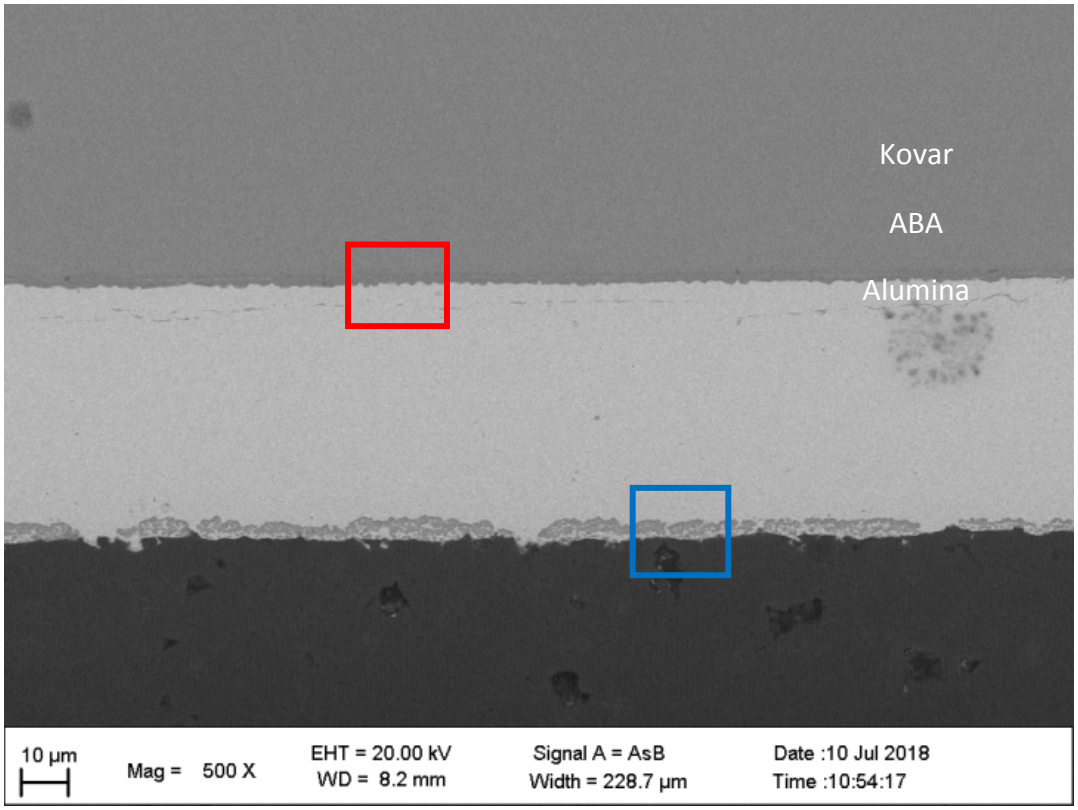


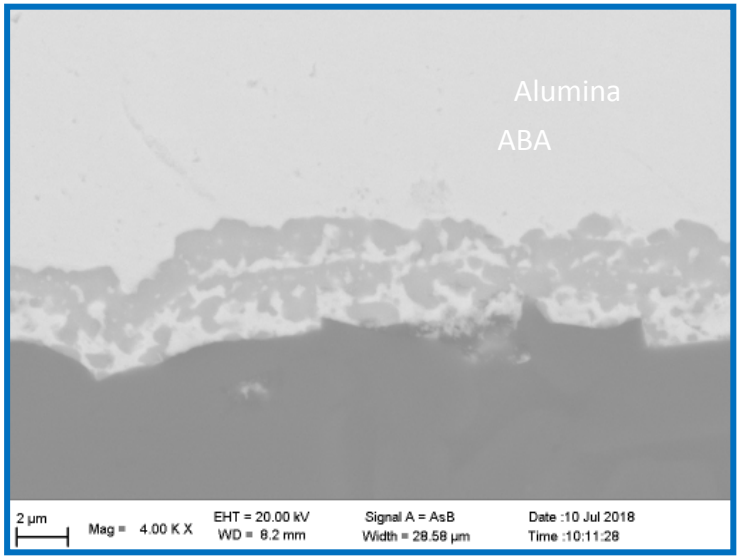
Kovar

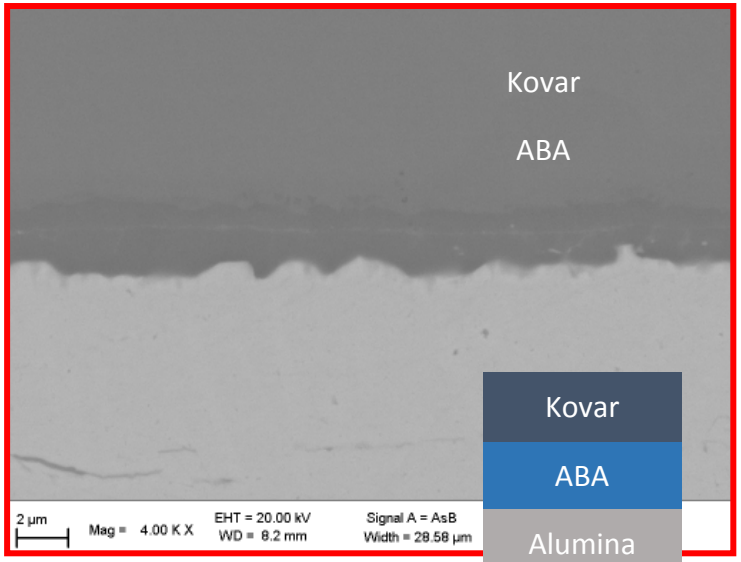
ABA

Alumina

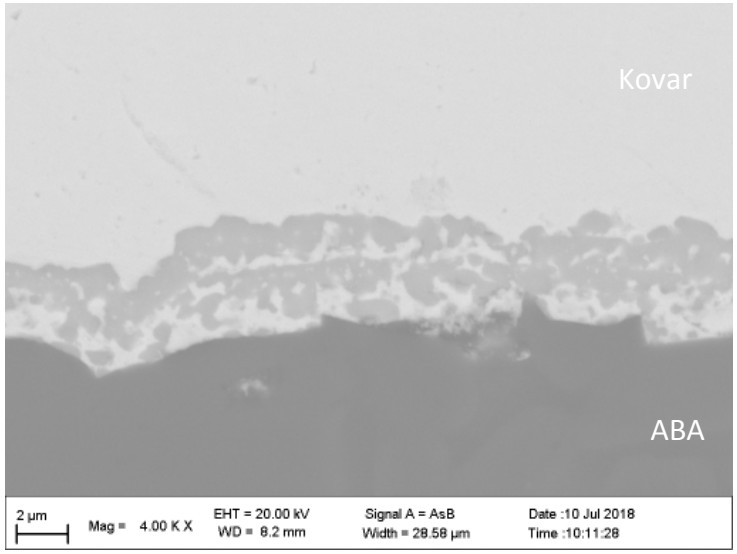
940°C

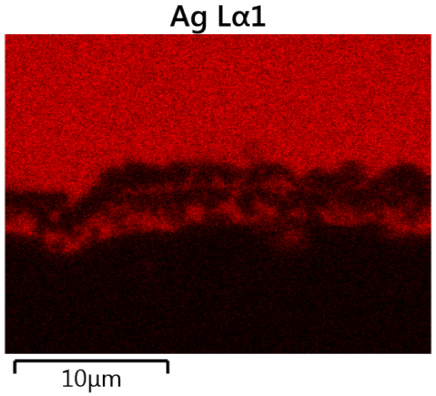

Kovar
ABA
Alumina
10 µm
Mag = 500 X
EHT = 20.00 kV
WD = 8.2 mm
Signal A = AsB
Width = 228.7 µm
Date :10 Jul 2018
Time :10:54:17

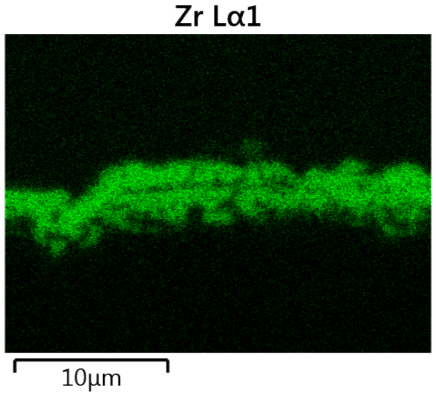

Alumina
ABA
2 µm
Mag = 4.00 K X
EHT = 20.00 kV
WD = 8.2 mm
Signal A = AsB
Width = 28.58 µm
Date :10 Jul 2018
Time :10:11:28

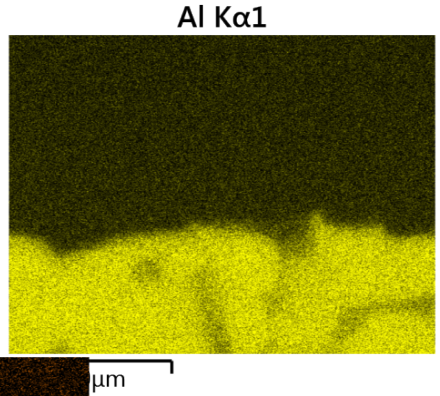

Kovar
ABA
2 µm
Mag = 4.00 K X
EHT = 20.00 kV
WD = 8.2 mm
Signal A = AsB
Width = 28.58 µm
Kovar
ABA
Alumina

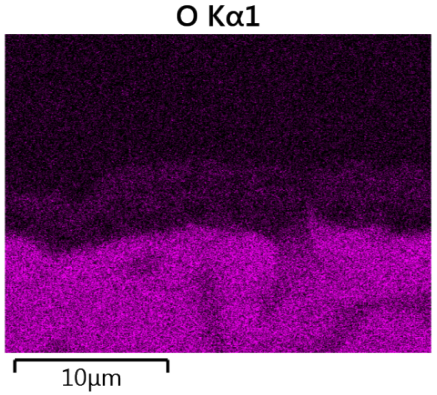
940°C

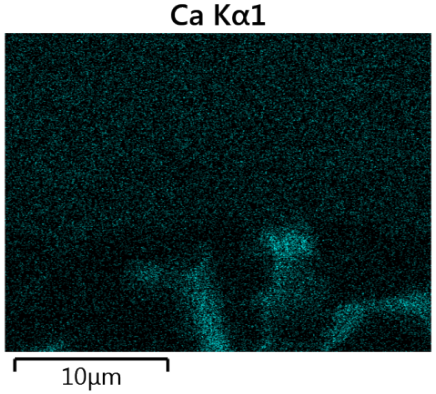


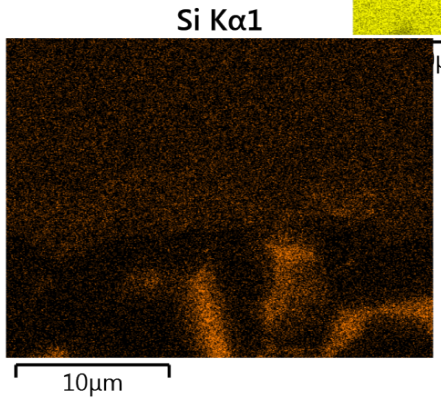








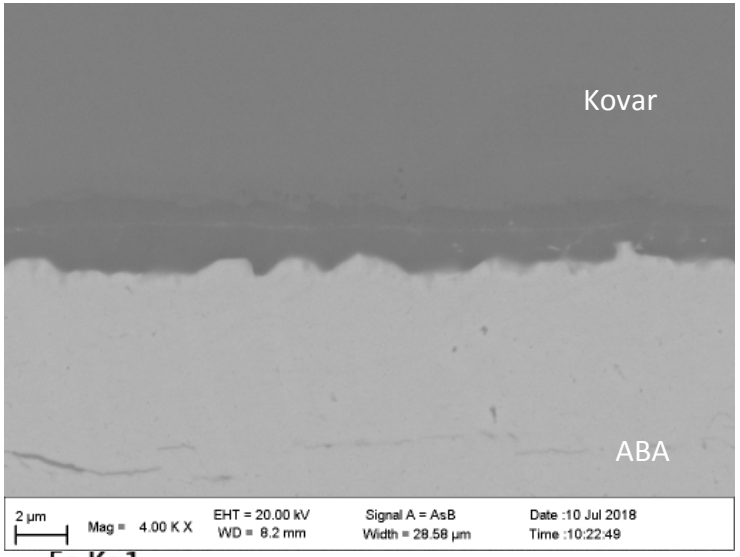


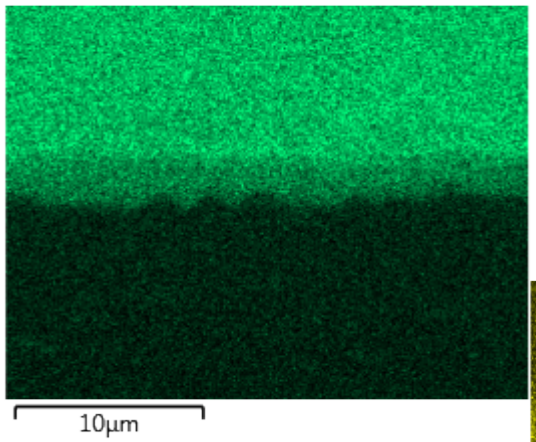


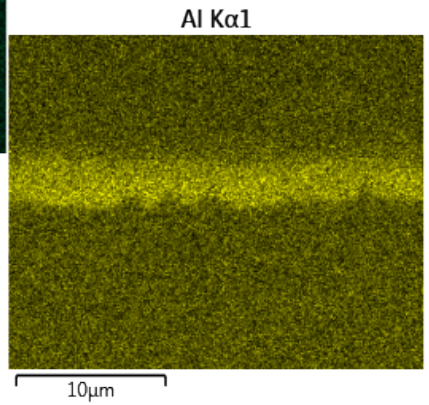
Si and Ca Glassy Phase
Al and O Layer AlO3 Ceramic
Ag and Zr Layer = Braze reaction layer

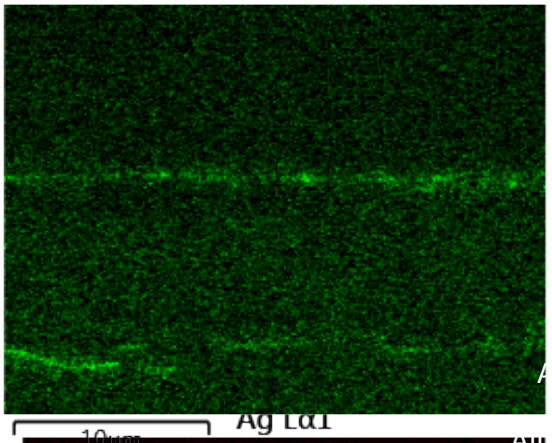
Kovar
ABA
Alumina

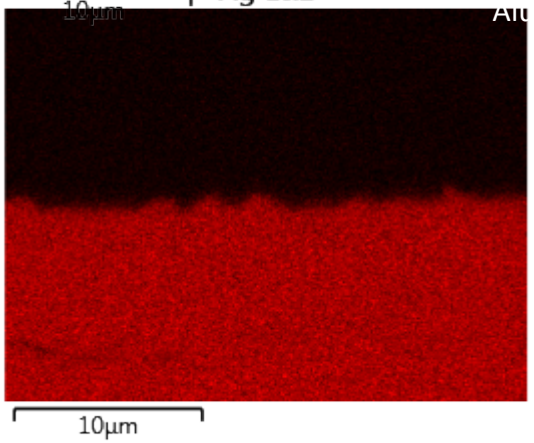
940°C





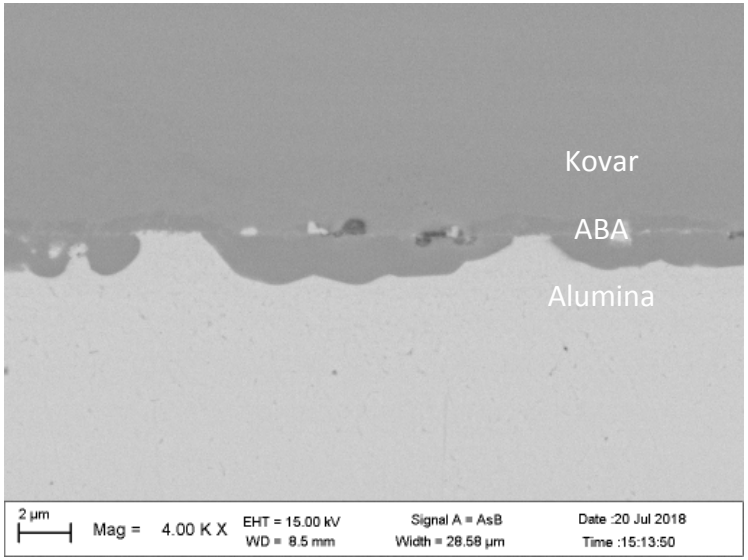




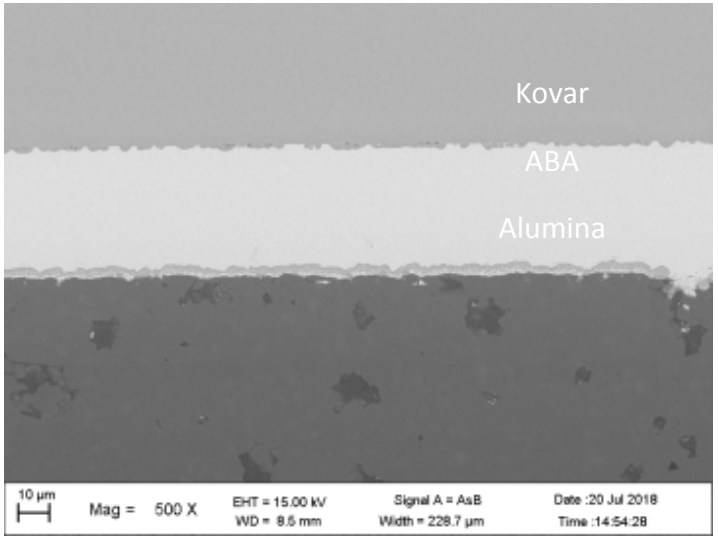


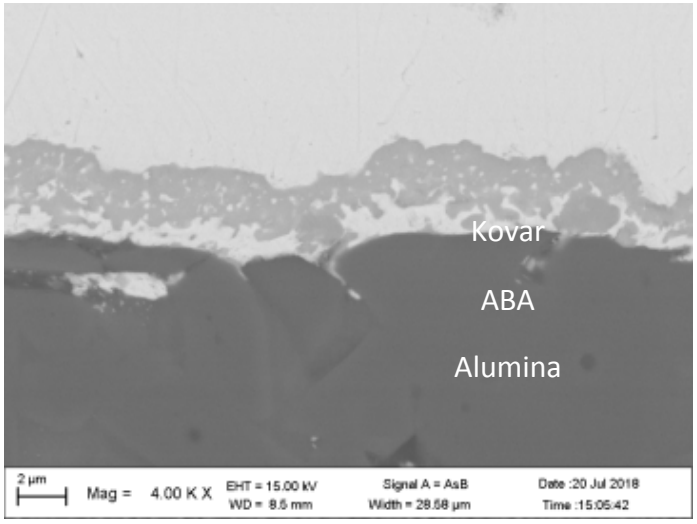
Layers of Fe, Ni, Co
Al Diffuses to Kovar Interface and forms layer
Thin Zr layer at Kovar Interface – “Lacy Phase”

Kovar
ABA
Alumina



960°C



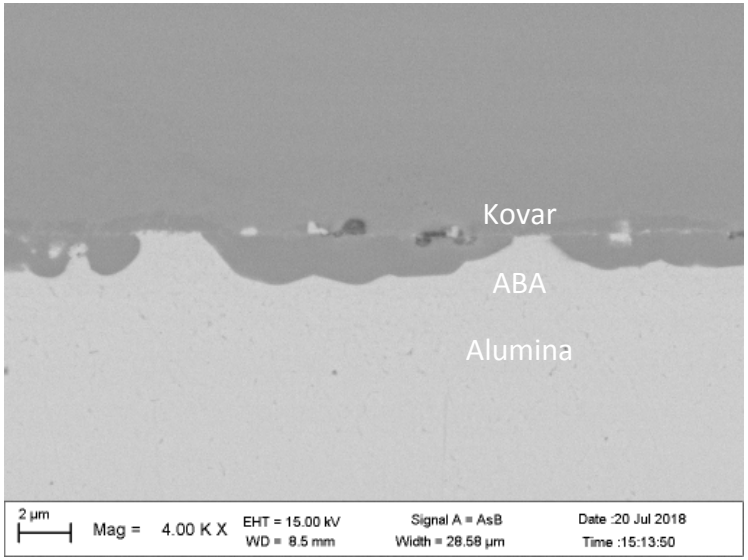


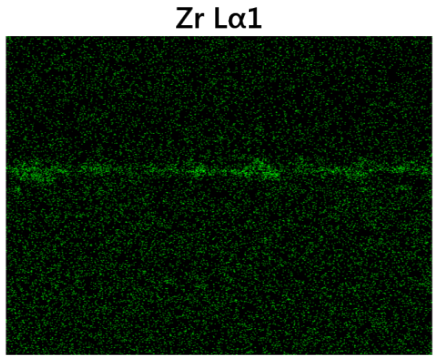
Kovar

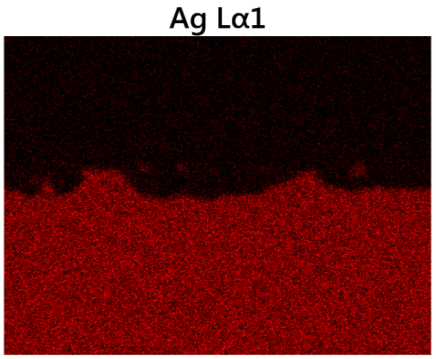
ABA

Alumina

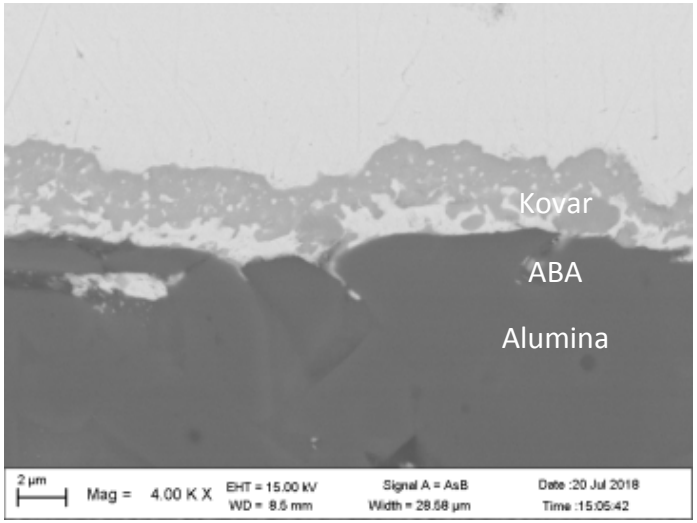
960°C

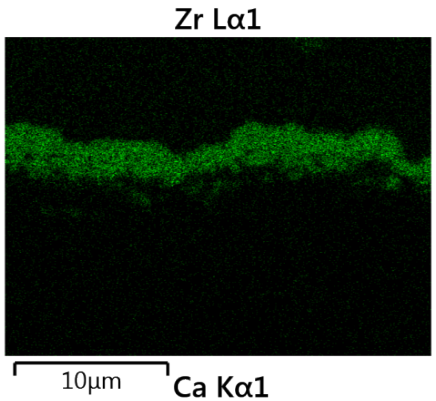


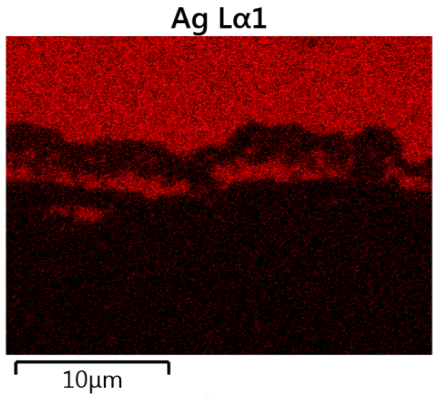


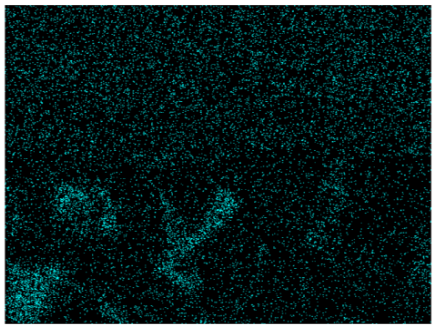


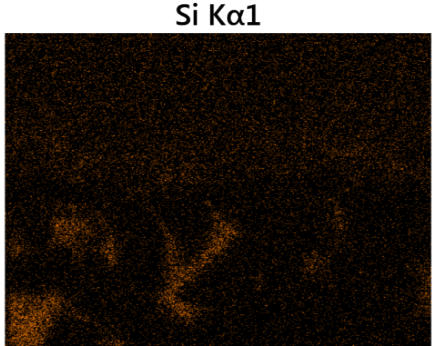
Absence of Zr “lacy phase”

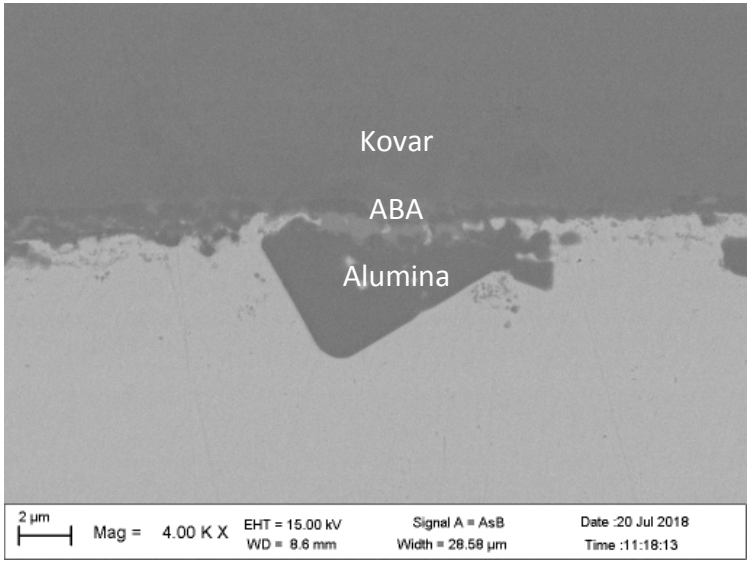


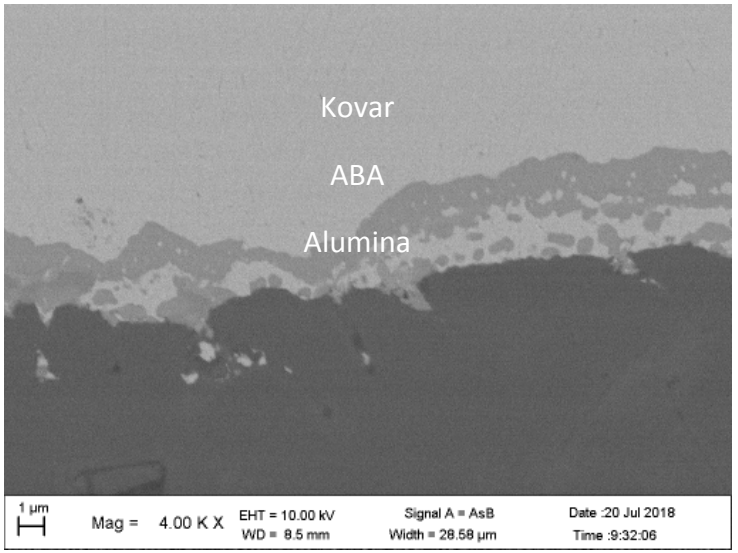




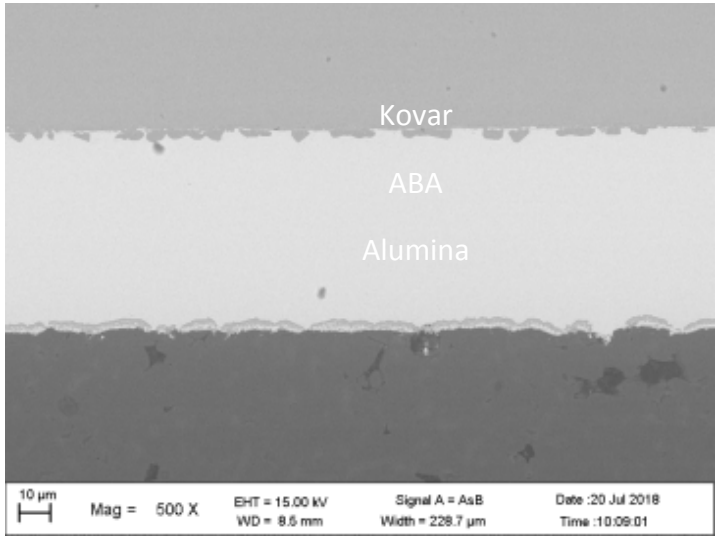








980°C



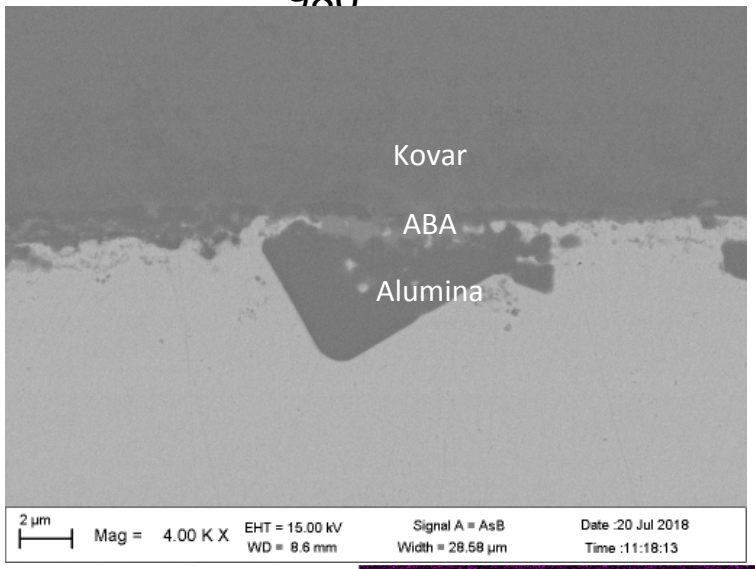
Kovar

ABA

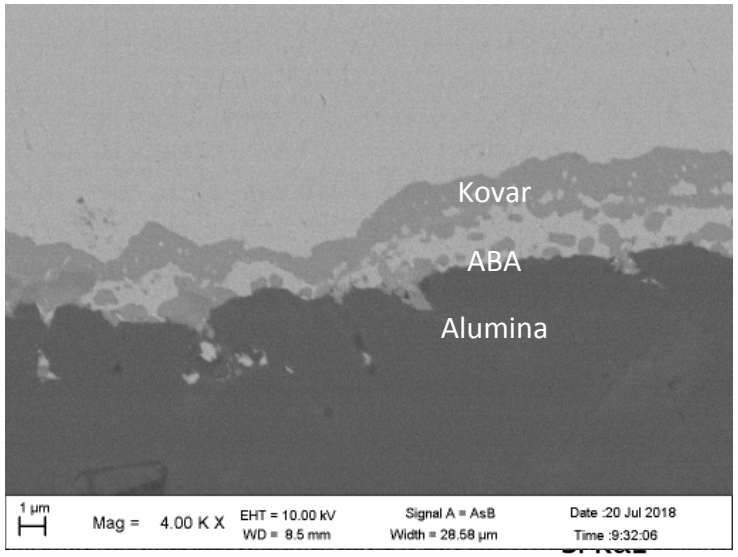
Alumina

Large chunks begin forming at kovar interface

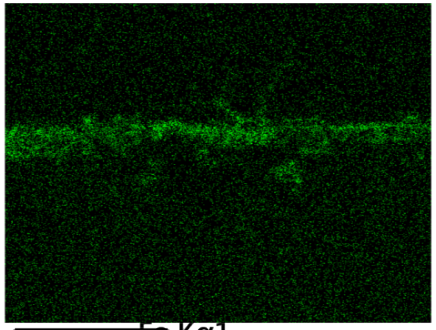
980

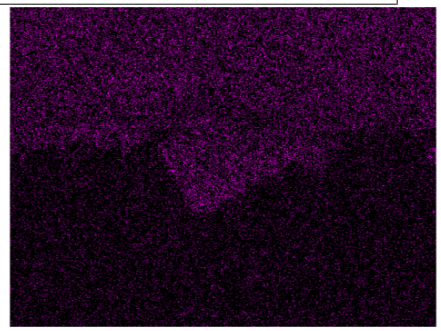


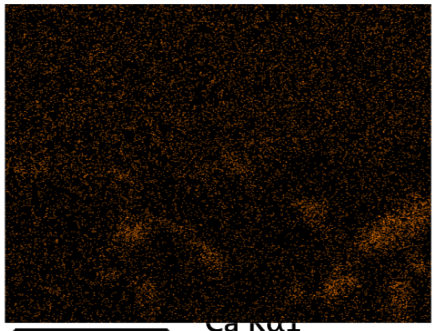
Glassy phase not as prevalent



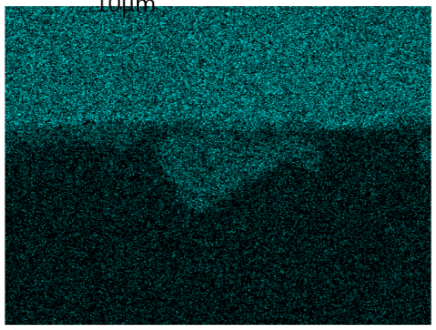
Zr Lα1



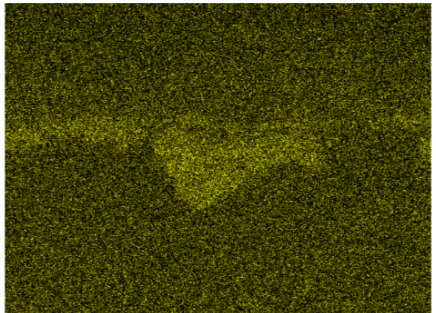




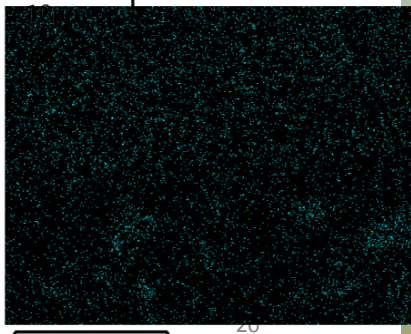
Fe Kα1



Al Kα1



Ca Kα1



Overview of Results

- Zr reaction layer on alumina interface did not change significantly
- Zr lacy phase reaction layer diffuses at higher temperatures
- Large Fe, Co, Ni, and Al chunks become visible at the Kovar interface
- Glassy phase begins to diffuse as temperatures increase

Future Studies

- Test samples with changing heat treatments
- Correlate microstructure to strength and hermeticity
  - Tensile testing to test strength
  - Hermeticity testing