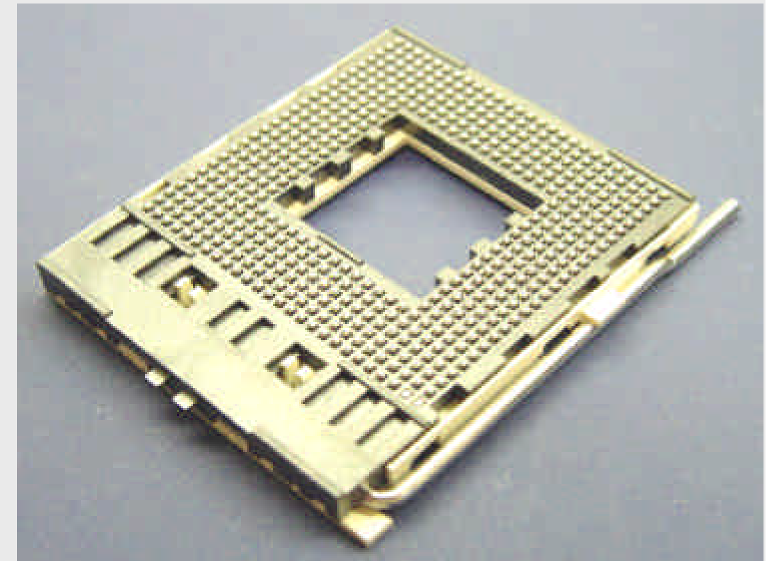
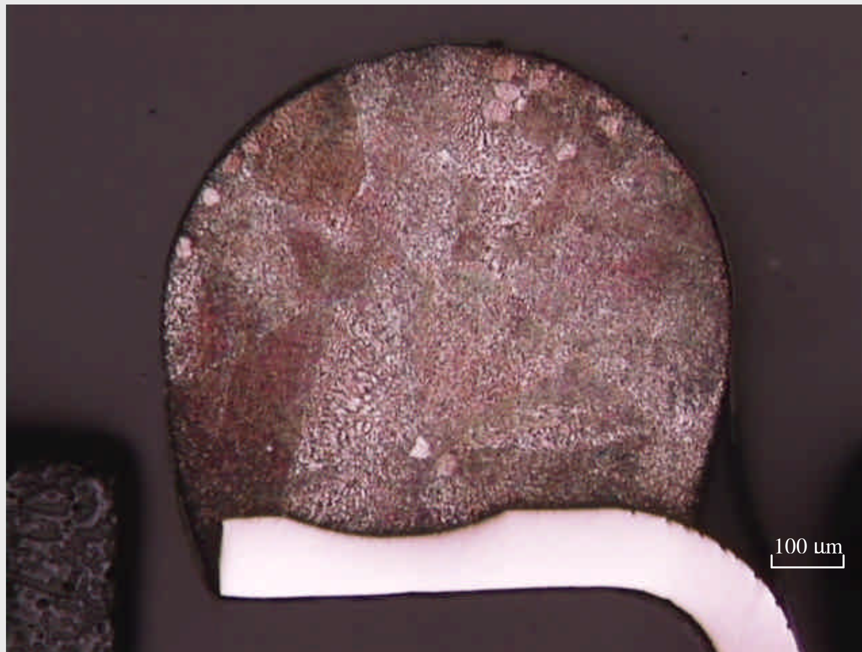
Lead-free: Solderballs and BGA

- Some products are currently offered with ball grid arrays (BGA)
- Current product uses a eutectic tin/lead solder ball
- Product testing on tin-silver-copper balls
  - No clean flux (higher temperature)
  - Only slighty higher reflow temperatures required to get good adhesion
  - Greater than 1000g/ball of shear strength
  - Good ball wetting angle
  - Ambient process atmosphere
  - Produces slightly thicker intermetallic
  - Intermetallic growth is:
    - Faster during reflow
    - Then slower at aging temp

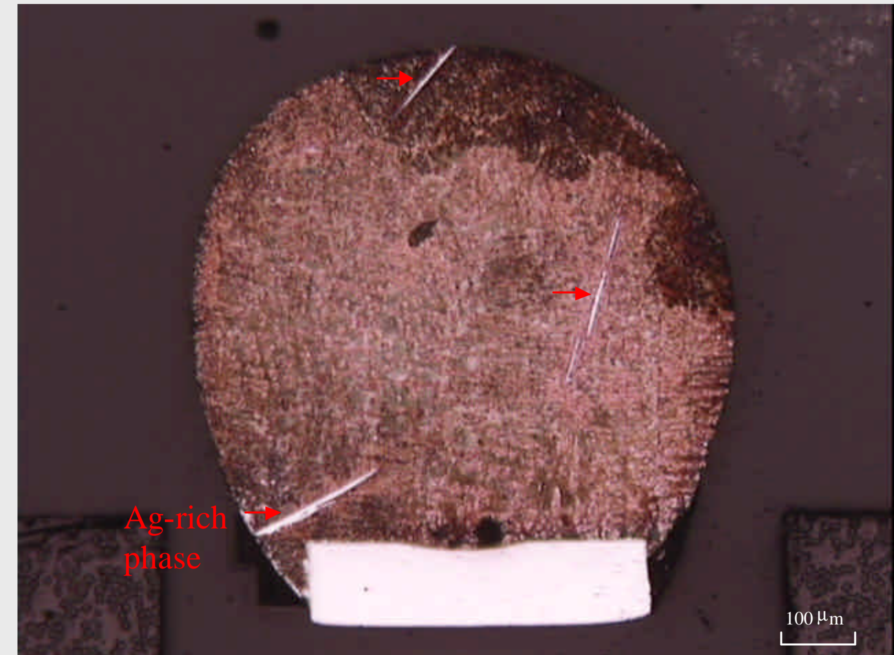


Lead-free: Solderballs and BGA

As-Reflowed Microstructure (Etched)

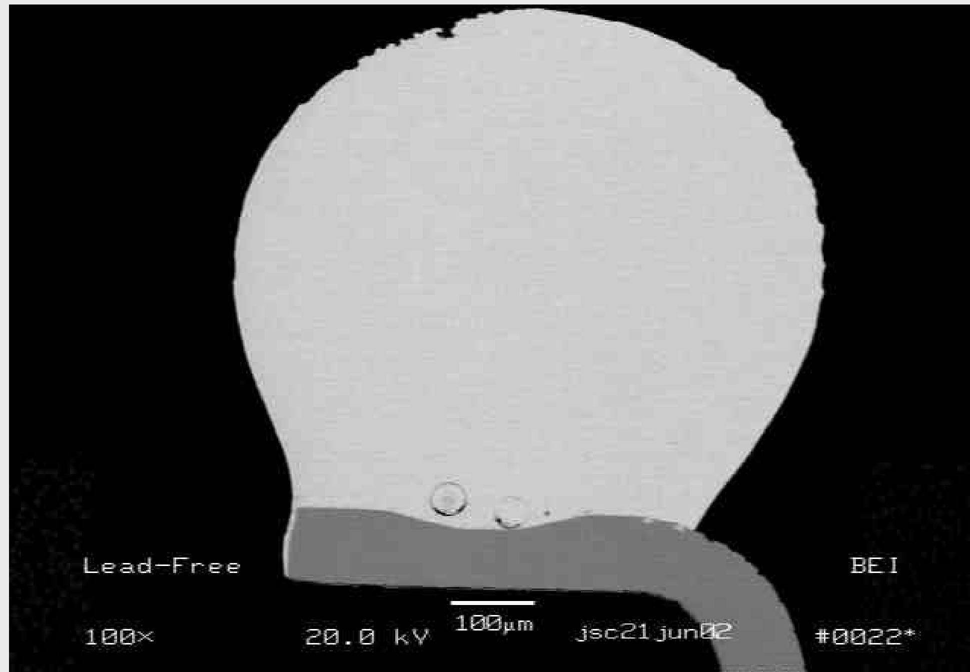


Eutectic SnPb
(Optical)

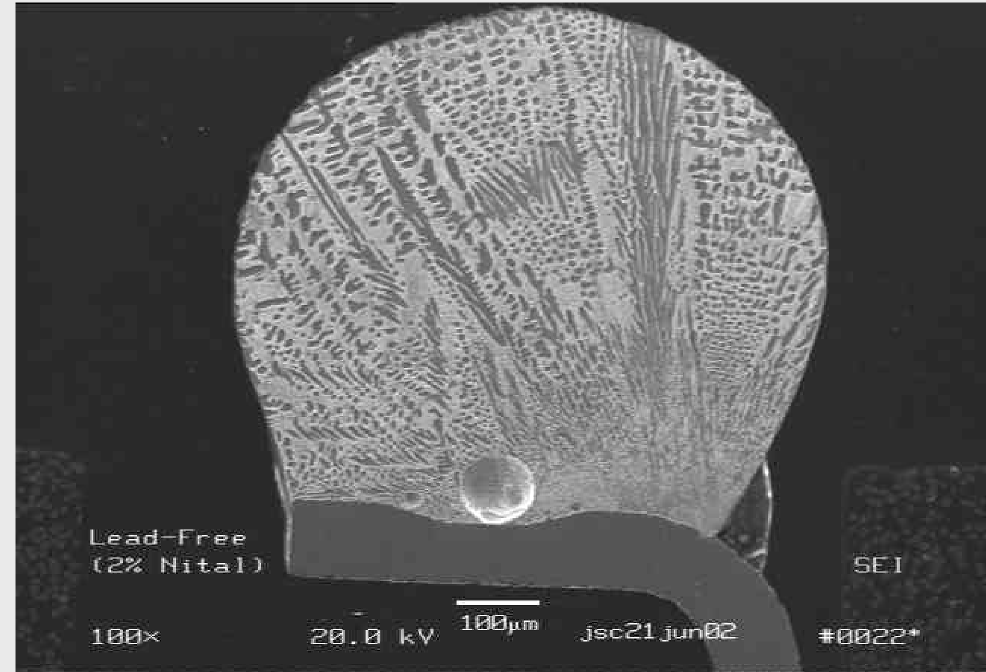


Near Eutectic SnAg/Cu
(Optical)

Good Wetting After Reflow (Lead-Free)



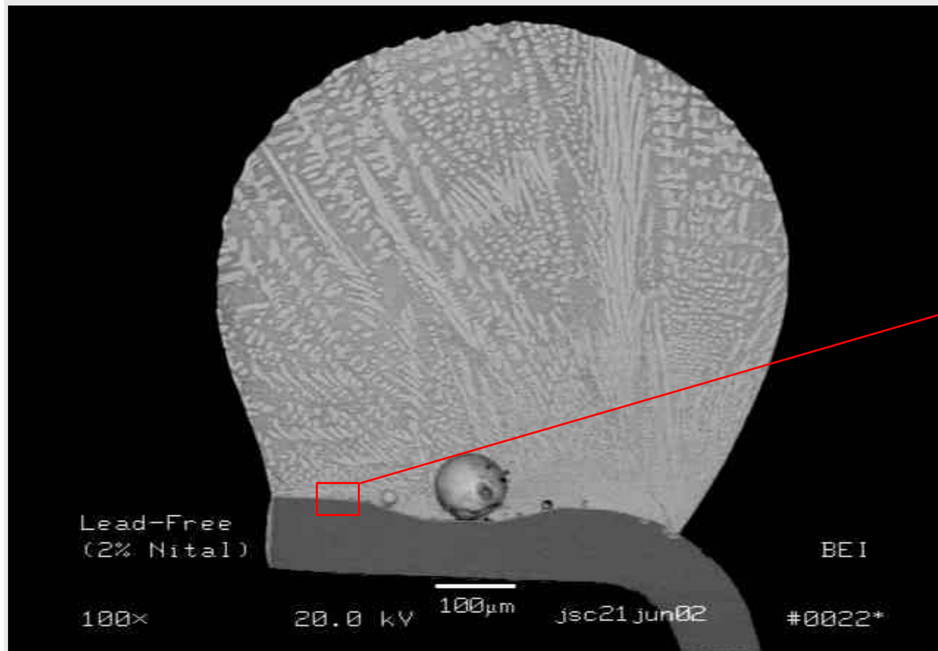
SEM BEI
(As-Polished)



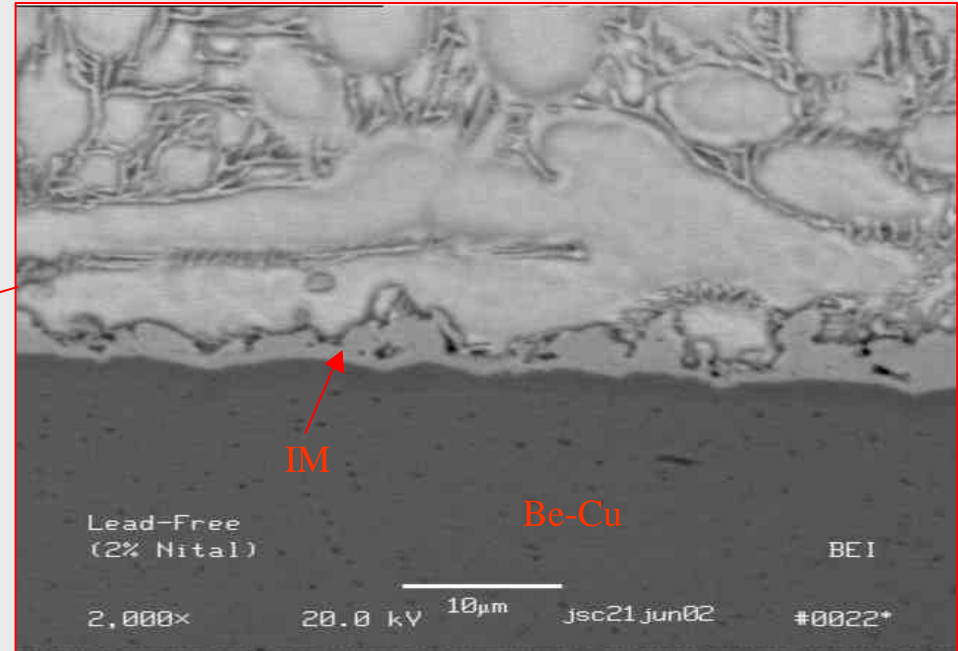
SEM SEI
(2% Nital Etched)

Solder Ball: 95.5Sn-4.0Ag-0.5Cu
Paddle: C17410 beryllium-copper overplated with 1.25 mm Ni
SEM BEI = Scanning Electron Microscope Backscatter Electron Image

Intermetallic Layer Formation After Reflow (Lead-Free)



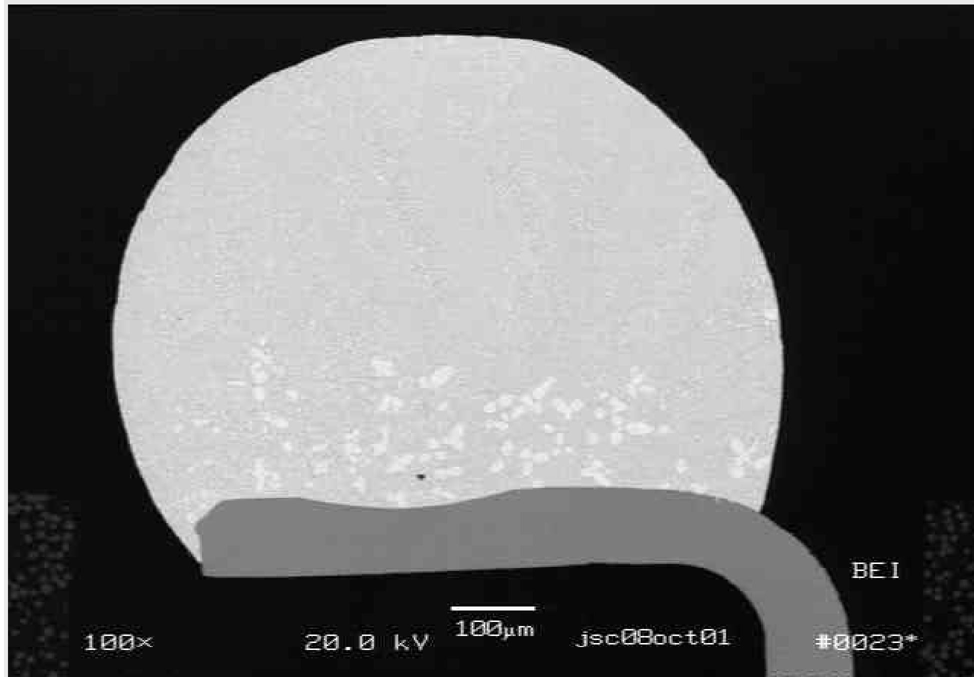
SEM BEI
(2% Nital Etched)



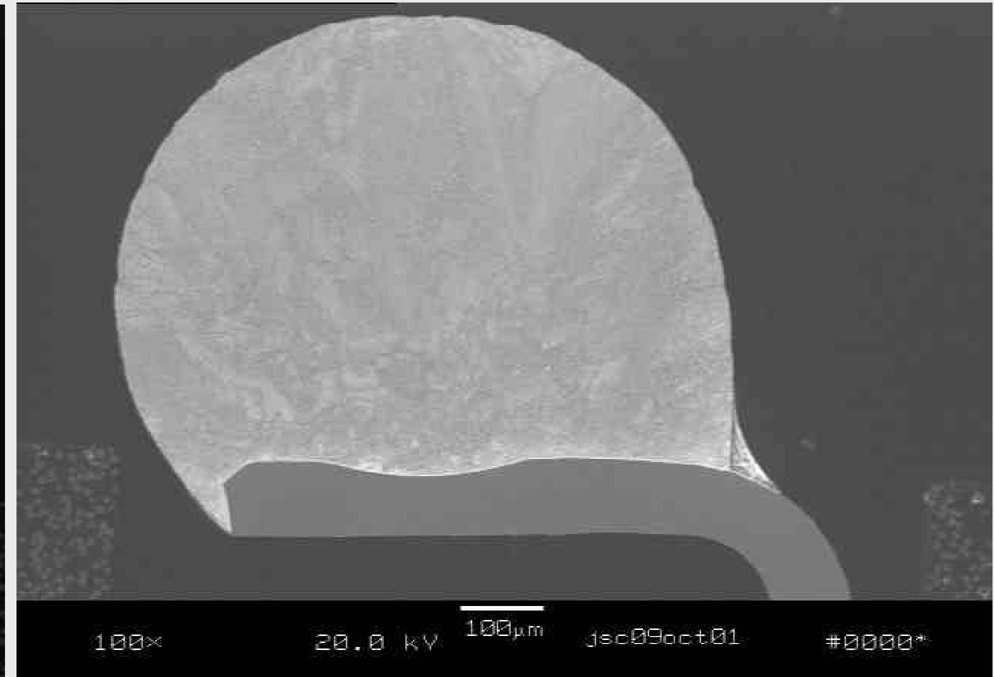
SEM BEI
(2% Nital Etched)

Solder Ball: 95.5Sn-4.0Ag-0.5Cu
Paddle: C17410 beryllium-copper overplated with 1.25 mm Ni
SEM BEI = Scanning Electron Microscope Backscatter Electron Image

Good Wetting After Reflow (Eutectic Sn/Pb)



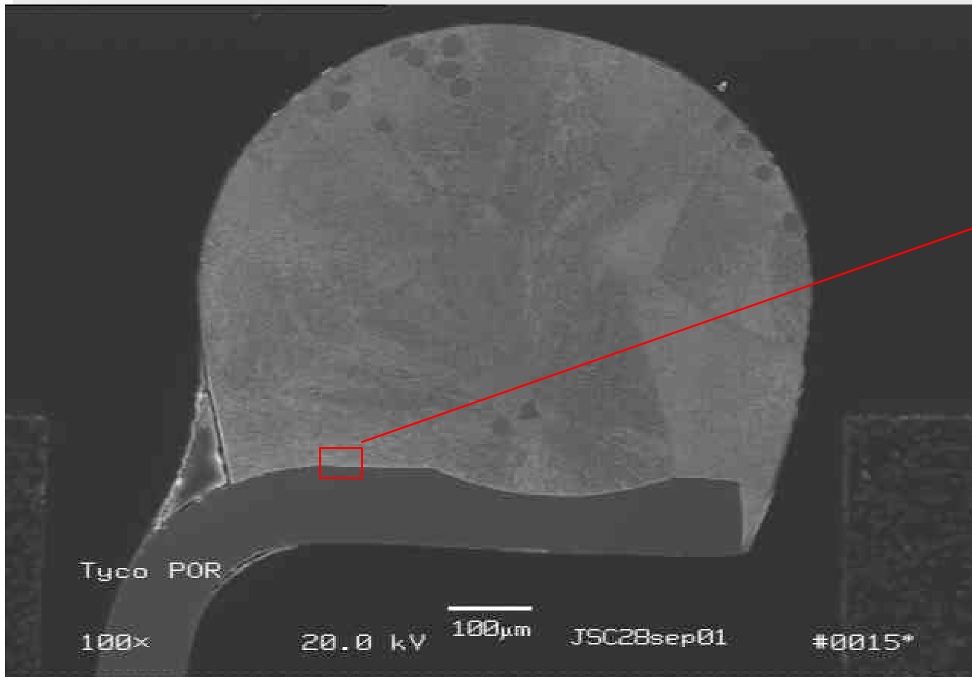
SEM BEI
(As-Polished)



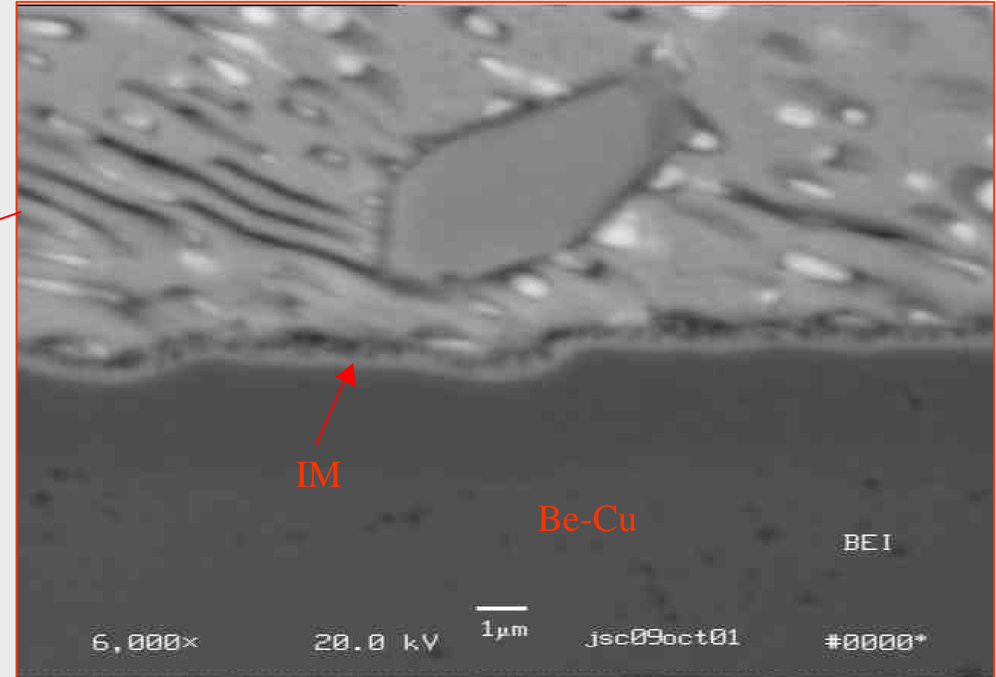
SEM SEI
(2% Nital Etched)

Solder Ball: eutectic Sn/Pb
Paddle: C17410 beryllium-copper overplated with 1.25 mm Ni with Au flash
SEM BEI = Scanning Electron Microscope Backscatter Electron Image

Intermetallic Layer Formation After Reflow (Eutectic Sn/Pb)



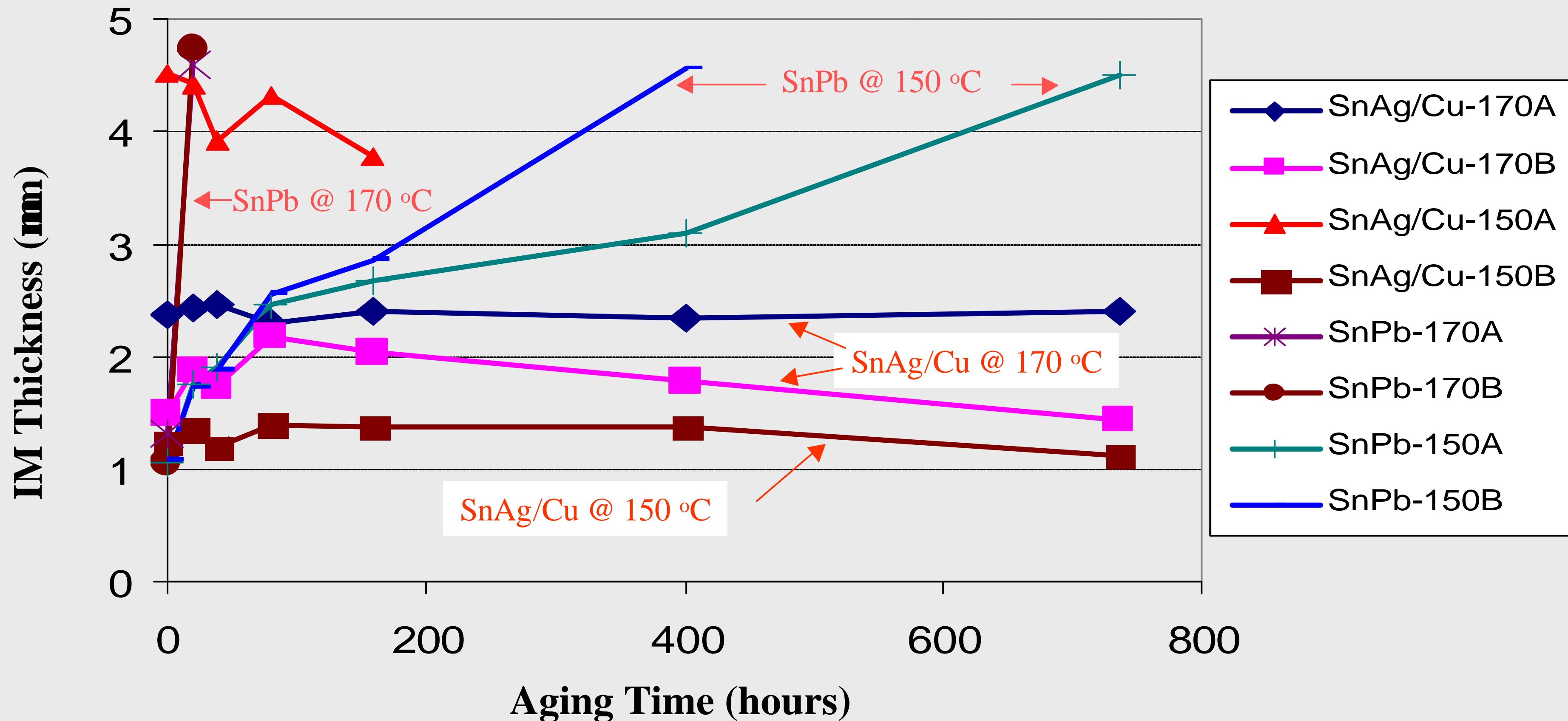
SEM SEI
(2% Nital Etched)



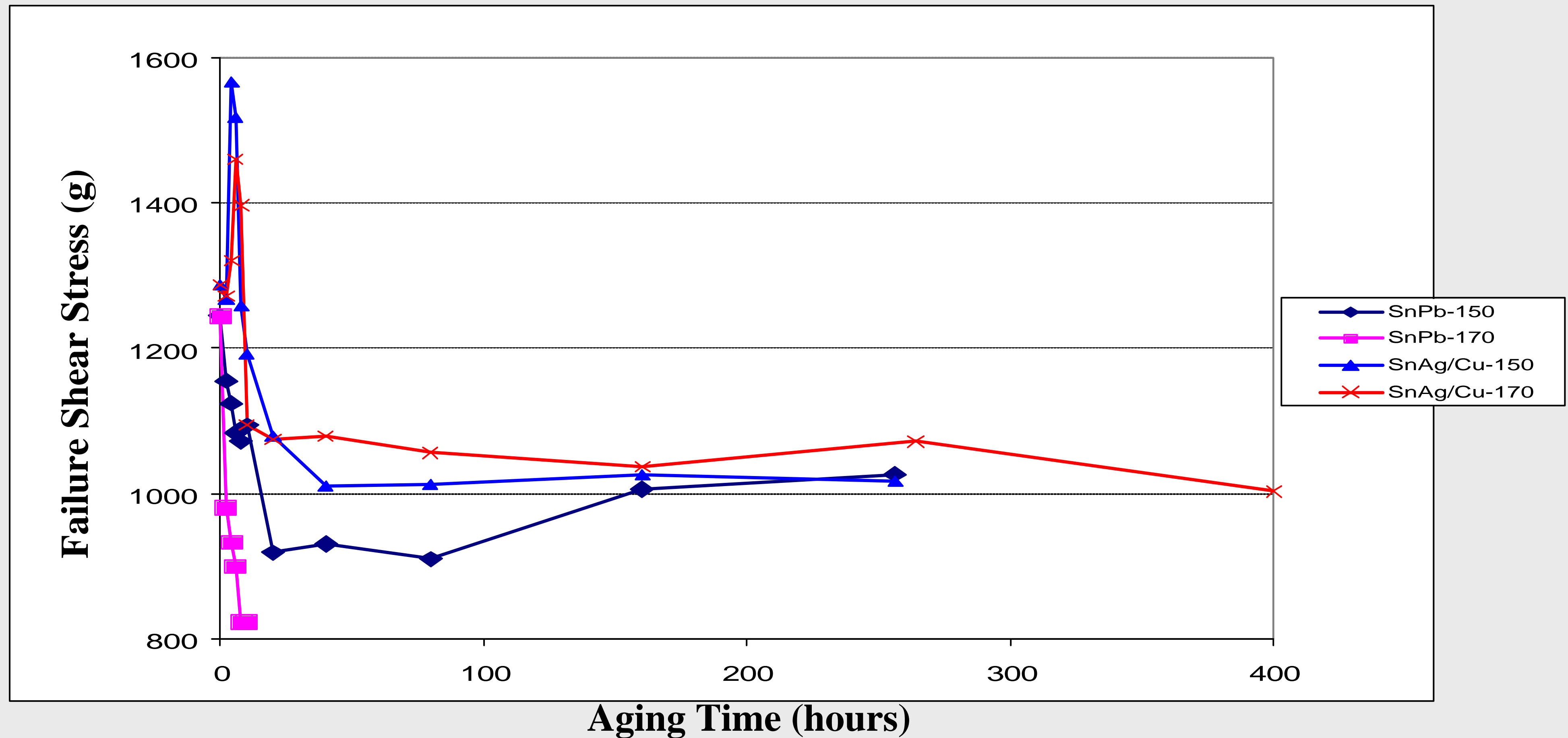
SEM BEI
(2% Nital Etched)

Solder Ball: eutectic Sn/Pb
Paddle: C17410 beryllium-copper overplated with 1.25 mm Ni with Au flash
SEM BEI = Scanning Electron Microscope Backscatter Electron Image

Intermetallic Thickness vs. Aging Time



Failure Shear Stress vs. Aging Time



BGA: Summary

- During reflow process, a faster intermetallic growth rate was found for SnAg/Cu compared to eutectic SnPb
- During thermal aging at 150 and 170 oC , a faster intermetallic growth rate was found for SnPb, but no clear intermetallic growth was observed for SnAg/Cu
- Failure shear stresses decrease as aging time increase for both SnPb and SnAg/Cu
- Better high temperature performance for SnAg/Cu than SnPb