HESSE MECHATRONICS

Hesse Mechatronics

Wire Bonding Technology

University California - Irvine

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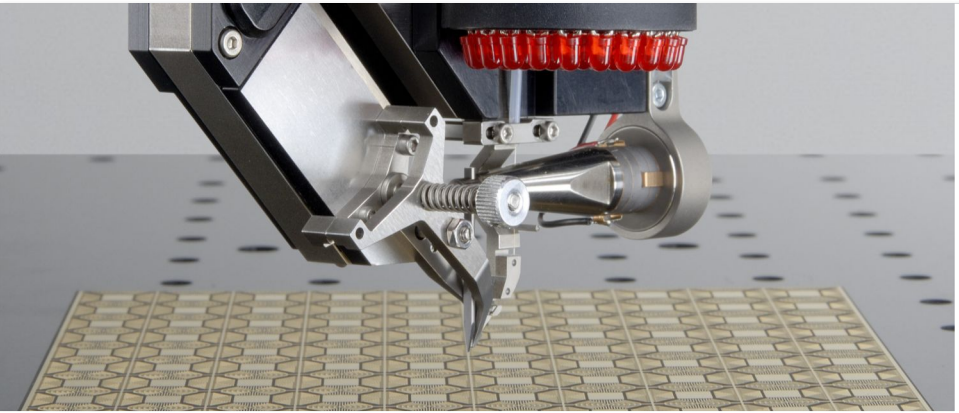
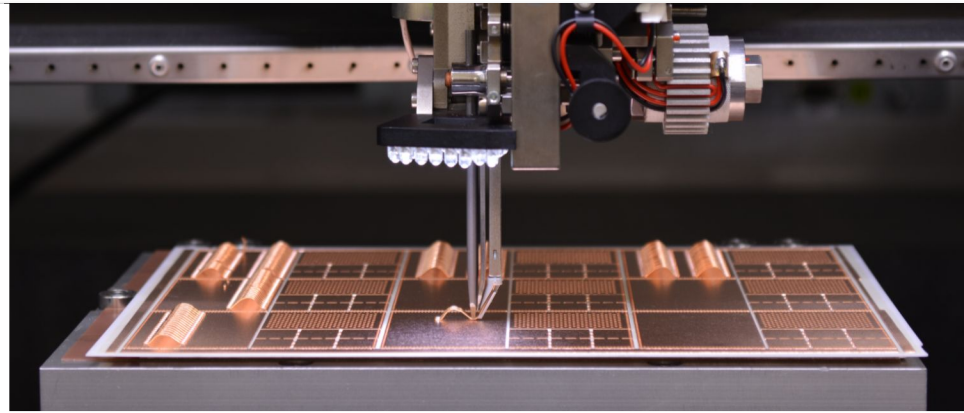
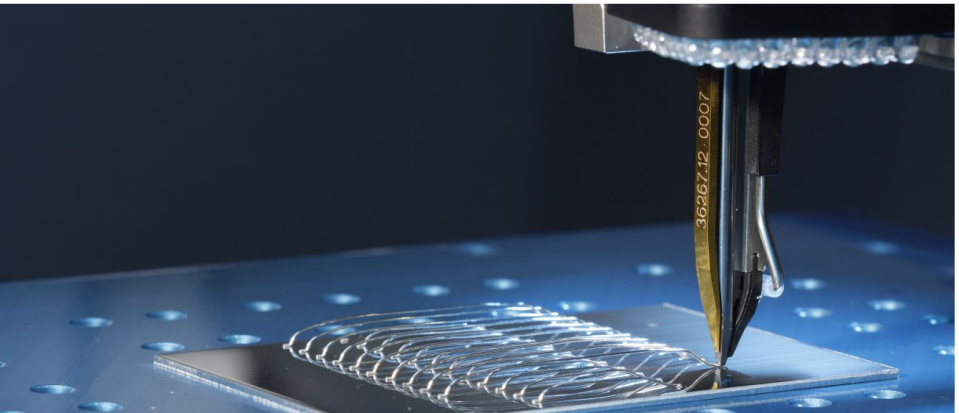
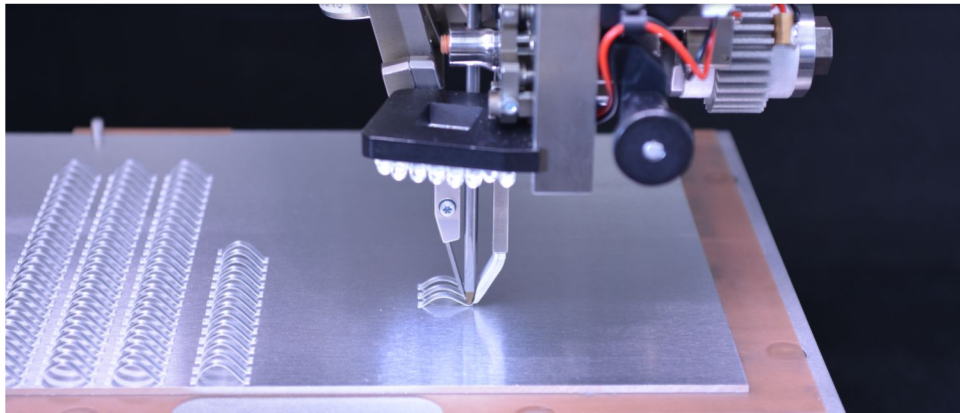
Various types of wire bonding technology









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Agenda

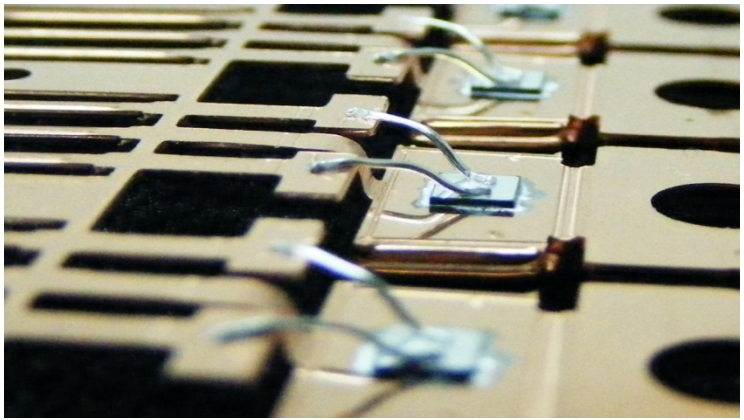
- What is a wire bond? Why use wire bonding?
- Quality Aspects of Wire Bonding
- What is the Future of Wire Bonding?
- Meeting today is to share with you who Hesse Mechatronics is, what wire bonding technology is all about and how we work with University California Irvine and industrial companies / research institutes / technical societies here in So Cal as well as the Americas.

Brief Introduction of Hesse & Wire Bonding

- Hesse Mechatronics
  - German-based, located in Paderborn, started as an automation company and then delved into wire bonding when the Berlin Wall collapsed
- Wire Bonding Technology
  - WWII patent, Bell Labs in NJ – late 1950's
  - Started as thermocompression – then thermosonic (1960's) – then ultrasonic (early 1970's)
  - Still very popular technology today, and getting into more and more applications.

What is a wire bond?

- A wire bond is a mechanical link between 1 or more points (usually 2) that provides an electrical bridge to permit current flow.
- A “wire” normally has 2 “bonds”, 1st and 2nd bonds.



Why use wire bonding? (and not soldering or welding)

- Flexibility – bond onto different metals, different heights, various loop heights
- Low Temp Process – Au is bonded at 150°C and Al wedge bonding is done at room temperature
- It is a “clean” process – no post cleaning
- Relatively fast – 1 wire per second to 20 wires per second

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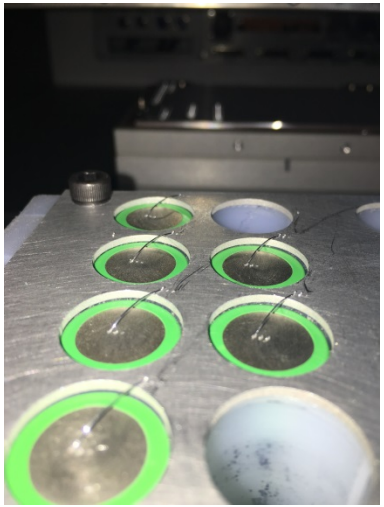
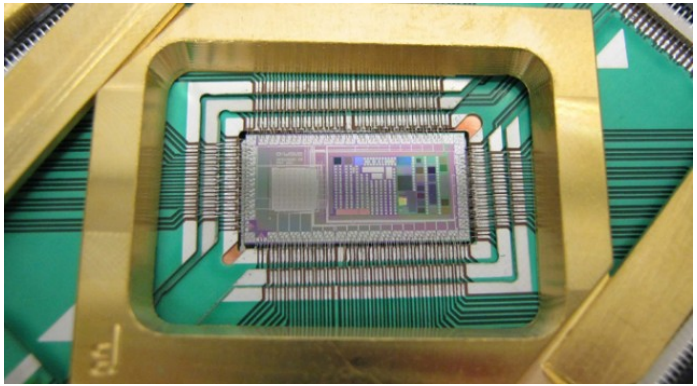
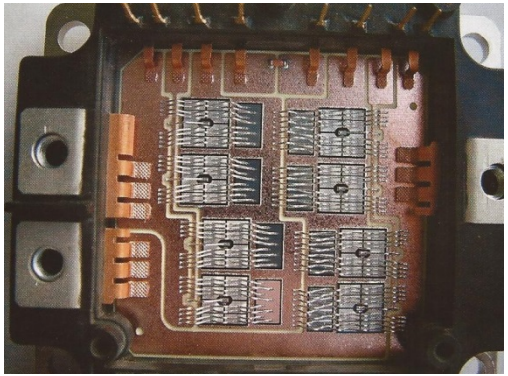
Where is it used? – Everywhere!

- Automotive: VR, MAF, DIS, Li-ion batteries, Sensors
- Medical: Defibulators, pacemakers, hearing aides, …
- Aerospace: power supplies, lighting, …
- Military: radar, missiles, …
- Consumer: games, laptops, …
- HiRel: down-well oil exploration, detectors, …
- Industrial: elevators, a/c heating systems, …
- RF/Microwave: base stations, cell phones, …

Various wire bonded applications





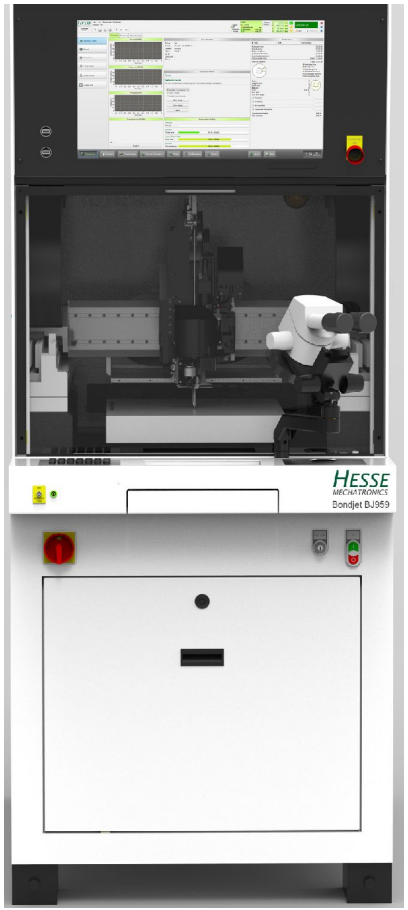


Slow Motion Video of a Heavy Wire Bond

Hesse & University California - Irvine

- We have two wire bonders installed in the Engineering Building
- BJ820 is for fine Al, Cu, Au wedge or ribbon.
- BJ959 is for heavy Al or Cu wedge or ribbon.

Bonders at University of CA Irvine



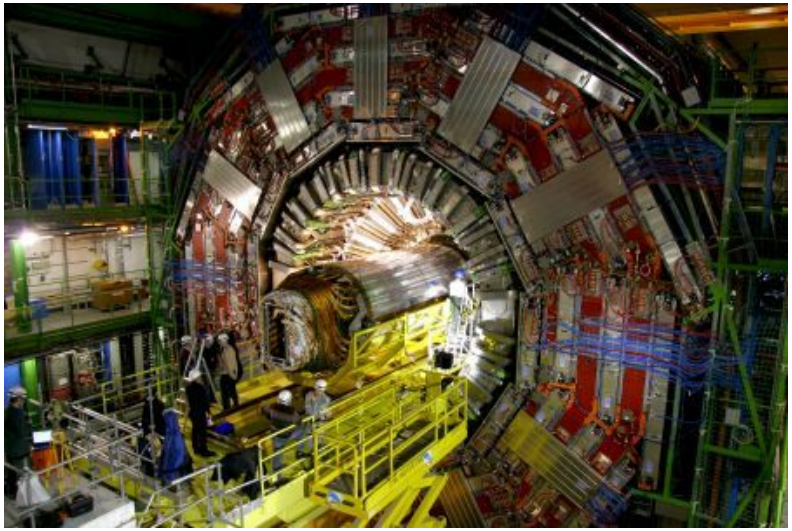
NC State: PREES and FREEDM Labs

- PREES and FREEDM are being funded by NSF and DOE.
- Hesse Bonder BJ935 is located in the PREES Lab

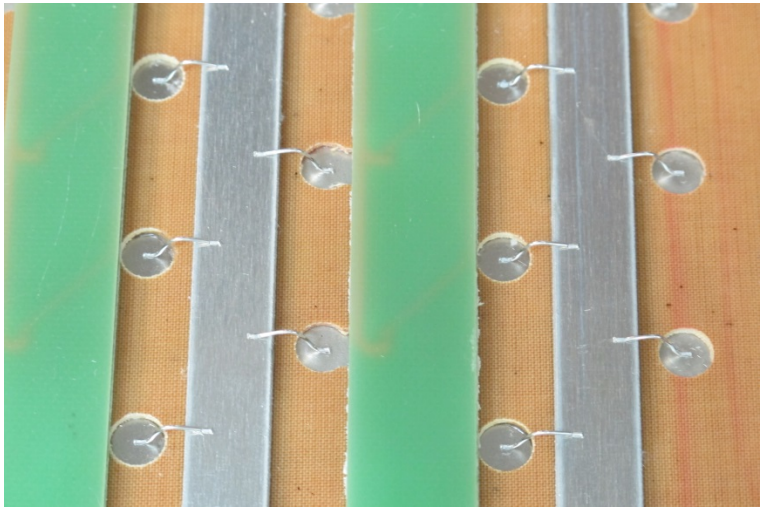
PowerAmerica at NC State – Wide Bandgap

Univ CA: Santa Barbara, Santa Cruz, LBL – BJ820

- CMS & Project – Particle Physics



Purdue Univ - Bonded battery for Formula1EV



Wire Bonding Definitions Part 1

- Atomic Bond
- Uses ultrasonic energy (and heat for Au / ball) to make the bond wire go “plastic”
- 120kHz for ball & fine wire
- 60kHz for heavy wire
- Other known frequencies: 40kHz, 110kHz, etc.

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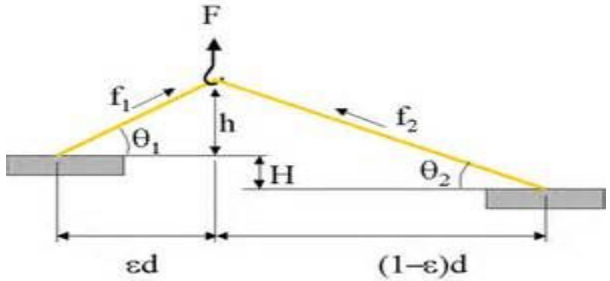
Testing Wire Bonds

- Pull Test
  - Lifts versus breaks
- Bond Shear Test
  - Shear Value
  - % Nugget
- Visual
  - “Neck”, “Heel”, tool-marks, cut marks

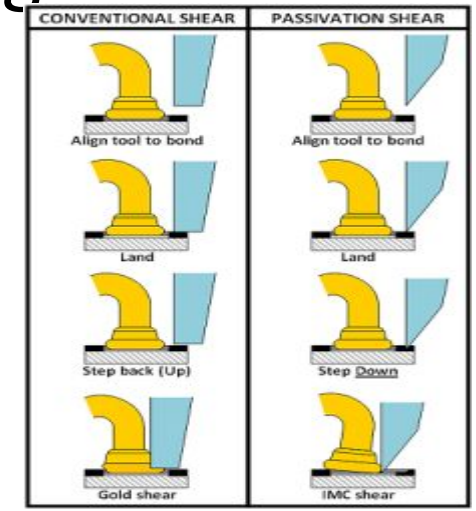
Pull Test

- Destruct Pull Testing
- Breaks versus Lifts
- Non-sticks during bonding



Bond Shear Test

- Destructive Bond Shear Testing
- Min Shear Value
- Min Nugget
- No existing standard for HW.



Visual

- Visual Inspection of wire bonds is very important.
- Heel damage for wedge
- Neck damage for ball
- Crescent formation for ball bonding
- Loop height, missing wires, lifted wires, scratched wires, damaged wires, etc.

Quality Aspects of Wire Bonding

- ASTM
  - F1269 Shear Testing of Ball Bonds
  - F72 Gold Wire
  - F205 Measuring Diameter of Fine Wire
  - F458 NDPT of Wire Bonds
  - No heavy wire standards!
- MIL-STD-883
- NDPT versus Destructive Pull Testing
- NDPT on a wire bonder vs on a bond tester

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Wire

- Wire Types: Au, Al, Cu, Ag, PtIr, Cu-Core, Pd-Cu
- Purity: 99.99%, 99.999%, 1%SiAl, .5%MgAl, Ni
- Tensile Strength: in grams
- Elongation: in %
- Spool: 2” DF, .5”, 4” (41B), 4” (41C)
- Shelf Life 6 months to 1 year
- Machine Life: Cu – 1 to 4 days
- Storage
- Handling

What is the Future of Wire Bonding?

- Ribbon/Foil Bonding (General Motors)
- Cu Wire Bonding
- Ultrasonic Interconnection
- Laser-assisted wire bonding

Plan Moving Forward

- Hesse Mechatronics is really looking forward to working with the faculty and students at the University of California Irvine.
- We have already had 2 electric truck companies visit, 1 medical company and many more lined up.
- We are working with IMAPS to restart the local student chapter here on campus.
- Plan on having students get involved with learning wire bonding and work with us on projects to be presented at technical conferences.

Thank you!

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Targeting 100%
Wire Bonding Yields

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