Project Description

- Evaluate adhesive bonding performance of Al and Cu for HVAC&R applications.
- Energy saving and easy manufacture process.
- Joining Cu and Al easily without galvanic corrosion.
- A reliable and leak-free technology.

Approach

- Identify the surface preparation method for adhesive bonding and evaluate the surface profile using SEM and profilometry.
- Define the joint strength requirement for adhesive bonding.
- Optimize the joint geometry using finite element analysis.
- Mechanical and reliability testing of joints
  - Pressure holding tests, shear tensile testing, DCB tests
  - Temperature/pressure cyclic and vibration tests, freezing tests
- Neutron imaging of bonding process in-situ (ORNL)
- Build heat exchanger and system with adhesive joins
  - Optimize the heat exchanger manufacturing process
  - Thermal performance of real refrigerant system

Discussion

- The structural adhesive is very strong for holding force and pressure; fatigue failure is the main concern.
- The required characteristics of adhesives are dependent on failure mechanism, which requires testing and simulations.
- The thickness of the adhesive needs to be carefully considered.

Results

Laser-Structured Surface Profile: SLP tensile test for failure mechanism:

- Laser etching can provide a structured surface for bonding without any chemical cleaning and mechanical sanding.
- For the adhesive used, fracture is main failure mode and the force is much higher than the hydraulic pressure. Fatigue needs to be studied.