Motivation and Goals

- Use the Non-Equilibrium Green’s function (NEGF) method to investigate effects of nanoscale emitter structures and vacuum gap on cooling power
- Validate NEGF simulation results with experiments

Technical Challenges

- Requires low work function (≈1 eV) emitters capable of stable emission
- Minimizing Joule heating is critical because cooling requires large electric currents

Nanoscale emitter structures and vacuum gaps offer the possibility of direct refrigeration devices capable of operating at efficiencies approaching the Carnot limit

Technical Approach

- NEGF approach provides accurate modeling of quantum effects
- Experimental results obtained from carbon nanotube emitters intercalated with cesium and potassium
- Experimental apparatus is capable of resolving cooling powers as low as 1 μW

Selected Publications