

THERMAL INTERFACE MATERIAL USING CARBON NANOTUBES

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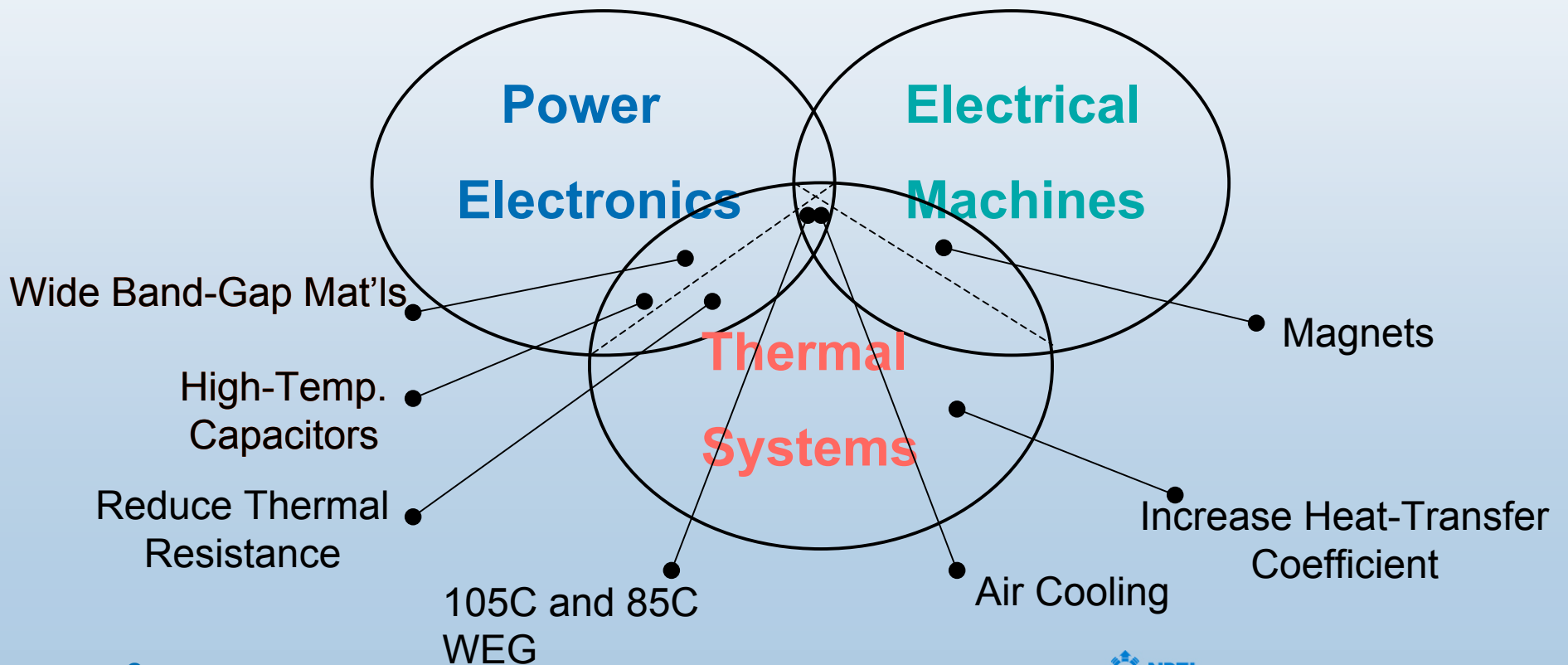
FY05 Budget: \$0K
FY06 Budget: \$250K

FreedomCAR APEEM Quarterly Program Review
Nov. 1-3, 2005



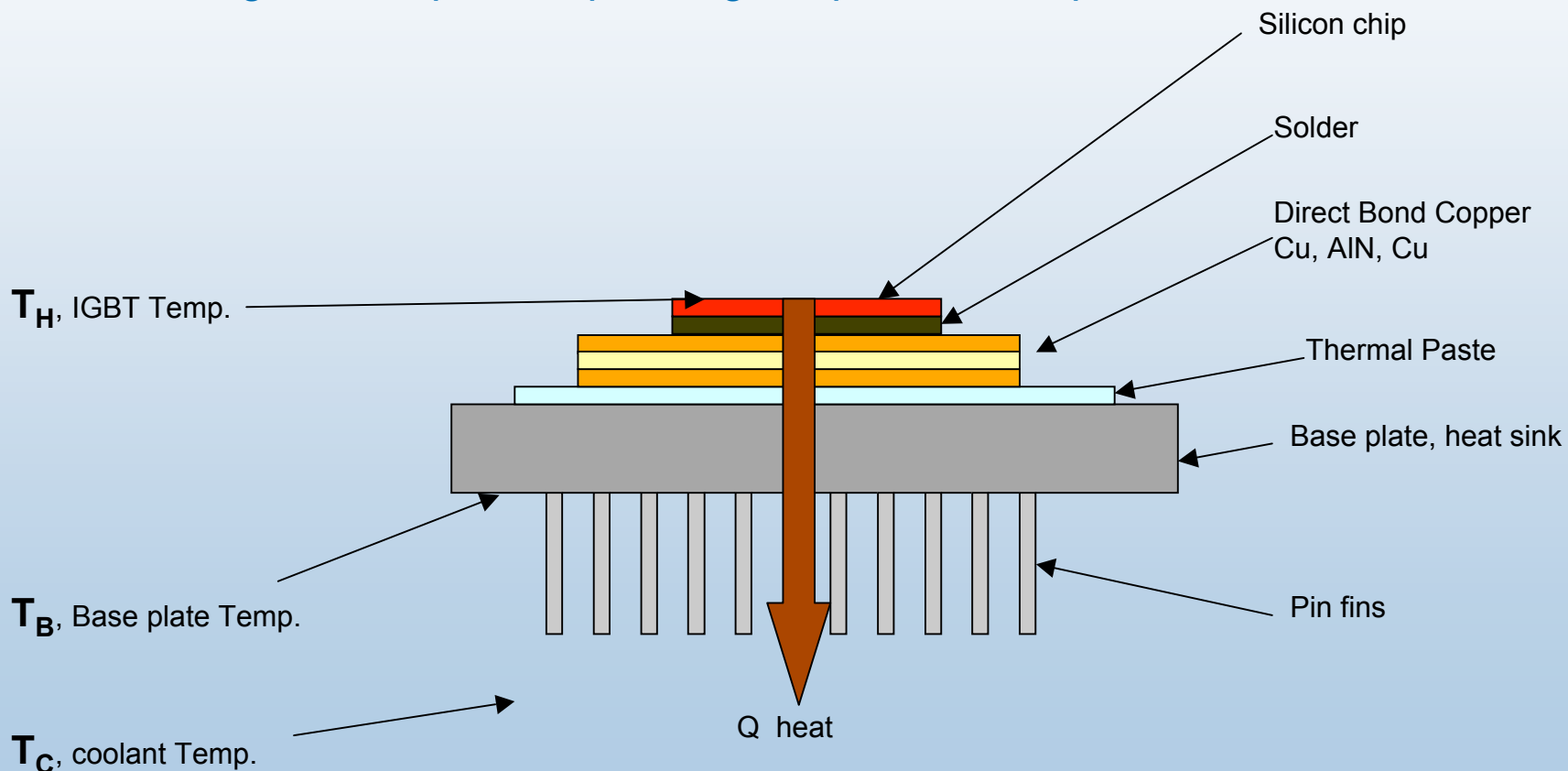
Where Does This Project Fit?

- Integrated cooling loop
- Inlet coolant at 105 °C for hybrid, 85 °C for FCV
- Heat fluxes at the order of up to 250 W/cm²
- Eventually, we would like to do air cooling by FY10 to FY15



Project Description

development of highly conductive thermal interface materials for maintaining an acceptable operating temperature for power electronics I



Goals

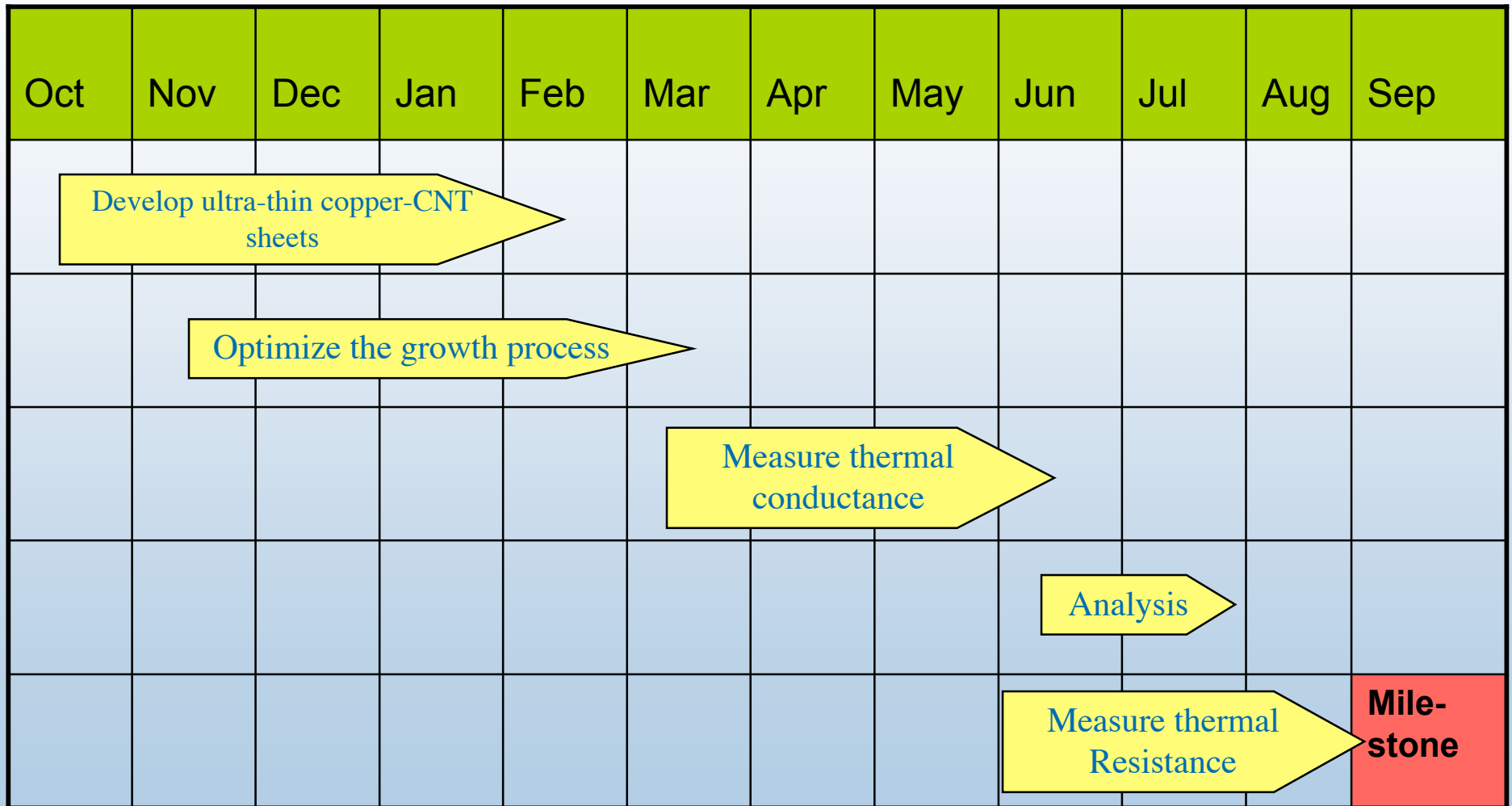
The goals of this project are:

- Increase the thermal conductivity of the existing thermal interface material by a factor of 6
- Grow carbon nano-tubes on Si or copper substrate
- Produce prototype material for testing
- Develop a nano-thermo foil TIM

Technical Approach

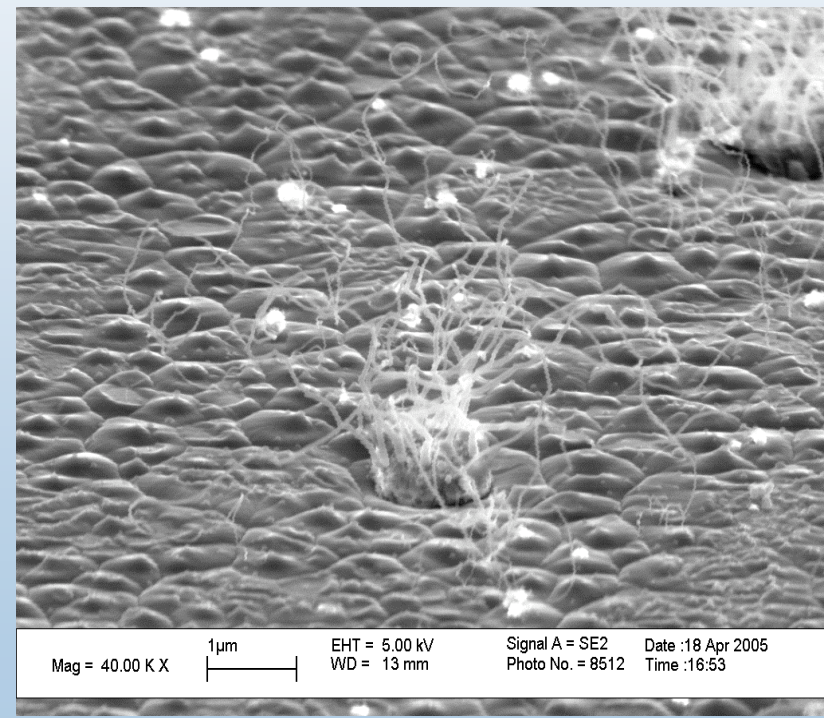
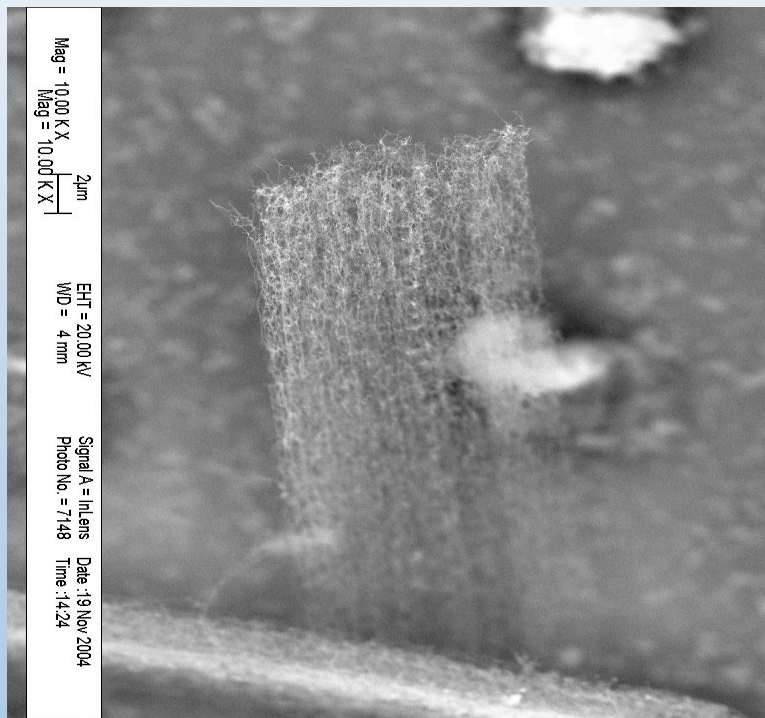
- Develop ultra-thin copper-CNT sheets as thermal interface material by synthesizing carbon nanotubes on copper(one side/both sides) using chemical vapor deposition
- Optimize the growth process for the nanothermofoil
- Measure thermal conductance of the nanothermofoil
- Compare the thermal conductance of the nanothermofoil with commercially available products
- Measure the contact resistance at the joint

Timeline for FY06



Barriers and Challenges

- Proper growth of carbon nano-tube/distribution
- Optimize the growth process for the nanothermofoil
- Overcoming the impact of contact resistance



Interactions and Collaborations

- University of Colorado, Boulder
- National Institute of Standards and Technology (NIST)