SHAPE-STABLE AND HIGHLY CONDUCTIVE NANO-PHASE-CHANGE MATERIALS

Technova Corporation

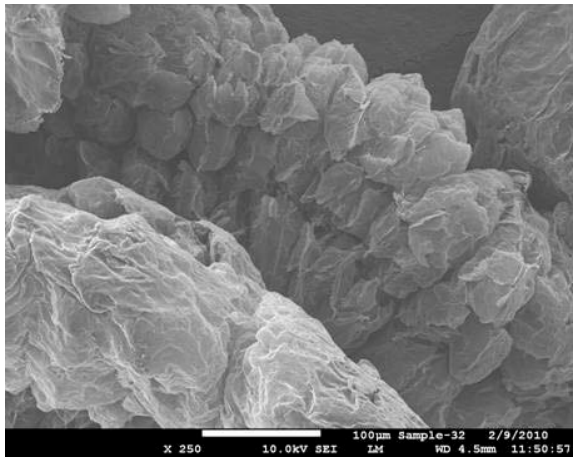
- **Technical Objective:**

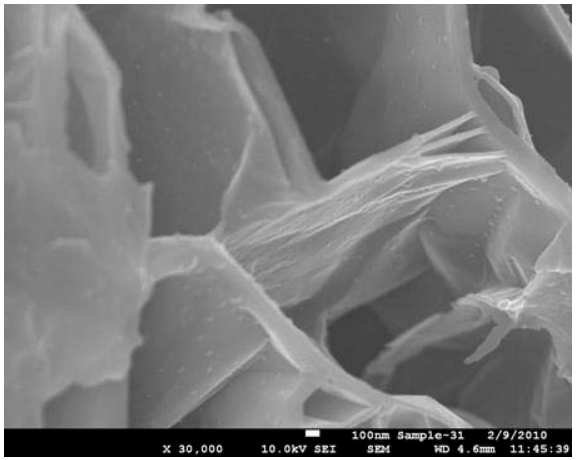
  Develop a new thermal energy storage (phase-change) material which complements high heat storage capacity with desired shape-stability, durability, thermal conductivity, scalability, economy, sustainability, and versatility for use towards enhancement of the energy efficiency of buildings and other systems.

- **Total cost of project:** $1.1 M (government) and $0.3 M (private)

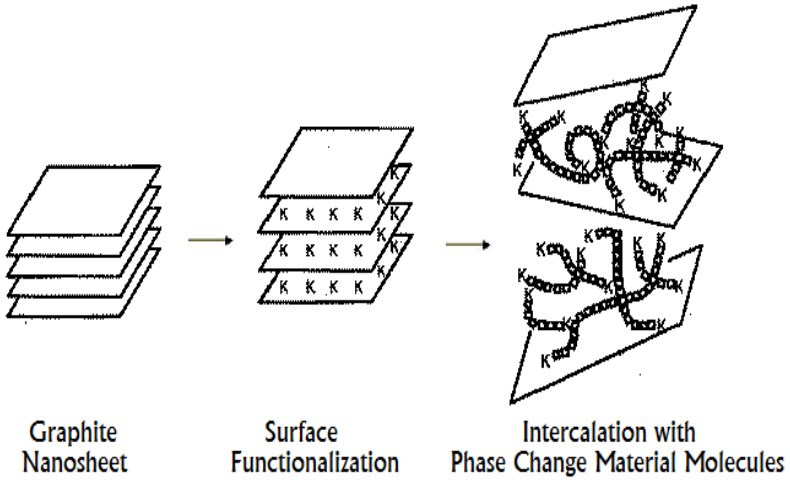
The Innovation

Graphite





Expanded Graphite Nanosheets



Schematics of the Approach

Distinguishing features of graphite nanosheets:

- Large specific surface area
- High thermal conductivity (1,250 W/m K)
- High aspect ratio
- Desired mechanical properties
- Low cost

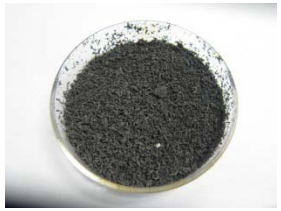
Scope of Work

- Refine the formulation and processing conditions of hybrid nano-PCMs for achieving a desired balance of thermal and mechanical attributes, long-term stability, fire resistance, scalability, sustainability and economy.
- Develop and thoroughly characterize building construction products incorporating hybrid nano-PCMS, and thoroughly assess their competitive performance and cost against existing products.
- Develop and validate models for the thermal performance of hybrid nano-PCMs and building products embodying them, and simulate and design building systems incorporating these products.
- Verify the field performance of building products incorporating hybrid nano-PCMs in terms of energy-efficiency, thermal comfort, initial and life-cycle economy, compatibility with common construction practices, and serviceability.
- Determine the competitive merits of the technology in terms of performance, initial and life-cycle economy, market appeal and sustainability.

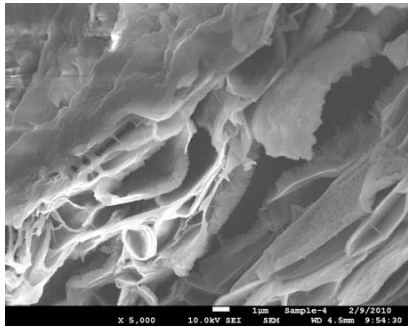
Accomplishments

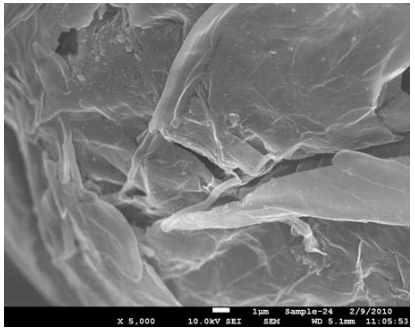
- An innovative phase change material (nano-PCM) was developed, which is shape-stable at elevated temperatures, and highly conductive for enhanced thermal storage and energy distribution.
- Nano-PCM was incorporated into building construction materials, such as polymer composites, gypsum boards, floor tiles and concrete materials which meet the relevant demands on engineering properties, and offer desired heat storage and thermal conductivity attributes.
- Field tests are currently in progress for validating the energy efficiency of building products incorporating nano-PCM.

Nano-PCM

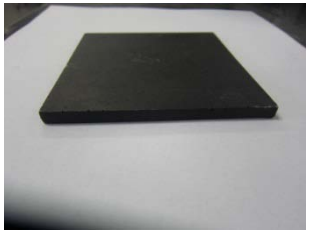


Visual Appearance





Building Products Incorporating Nano-PCM



Polymer Composite

Gypsum Board

Floor Tile

Concrete

Expected Outcomes & Next Step

- Full-line of building construction products incorporating nano-PCM
  - Formulations and production conditions
  - Performance characteristics
  - Cost structures
- Market transition of the technology, in collaboration with manufactures of building construction products
- Next Step: Refinement, thorough characterization, scaled-up production and field evaluation of building construction products incorporating nano-PCM.