Freeze-Cast Titanium Oxide Foams in Microgravity
for Dye-Sensitized Solar Cell Applications
Titanium oxide nanoparticles are suspended in water and placed in containers (1).
During periods of microgravity, containers are placed on top of the freezing substrate (i.e. a copper box filled with dry ice) to initiate growth of ice dendrites (2).
Ice dendrites grow perpendicular to the freezing surface; as they grow, the titanium oxide particles pack in between the dendrites (2).
After microgravity flight, ice dendrites are removed and elongated pores, replicating the dendrites, remain (3).
Samples are subsequently sintered to densify pore walls.

Freeze-Casting Process

- A novel, environmentally friendly technique for the fabrication of highly-ordered, three-dimensional electrodes that utilizes a microgravity environment to improve the scientific understanding of solidification behavior.
- Electrodes solidified in microgravity during initial testing exhibited improved pore orientation as compared to those solidified under terrestrial conditions.
- To improve upon initial microgravity results, this current work seeks to decrease pore sizes, while maintaining the desired pore orientation by:
  - Increasing the percentage of titanium oxide in suspensions, and
  - Decreasing the solidification temperature.
- Knowledge gained through this research will enhance the ability to adjust microstructural properties of freeze-cast materials for improved, terrestrially-based electrode fabrication.

Dye-Sensitized Solar Cell Electrode Fabrication

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