ENHANCING THE THROUGH THICKNESS THERMAL CONDUCTIVITY OF COMPOSITES

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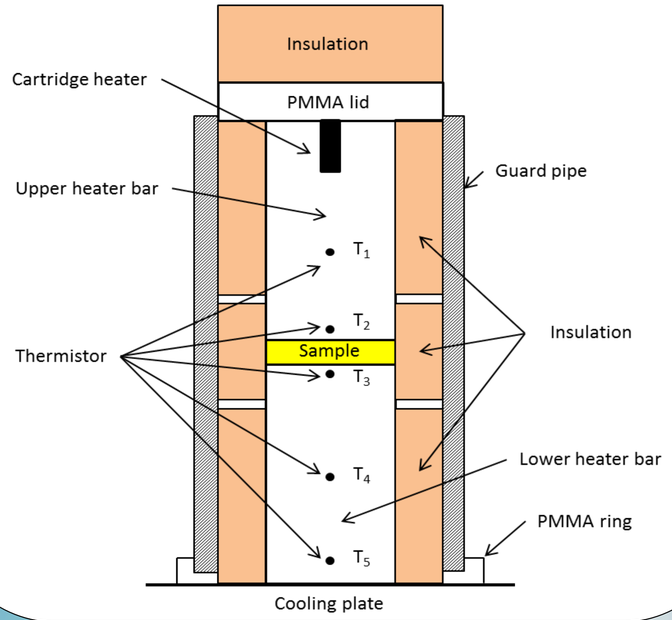
PURPOSE

- Use of composites is limited when the application requires high rate of heat transfer due to their poor thermal conductivity in the thickness direction.
- The objective of the research is to characterize the effective thermal conductivity of composites when carbon nanotubes are dispersed within the matrix material.
- The motivation is to formulate a predictive model to describe the heat transfer in heterogeneous materials and calculate the effective thermal conductivity.
- A thermal conductivity cell was designed, fabricated and calibrated to measure thermal conductive of heterogeneous materials

THERMAL CONDUCTIVITY TEST CELL



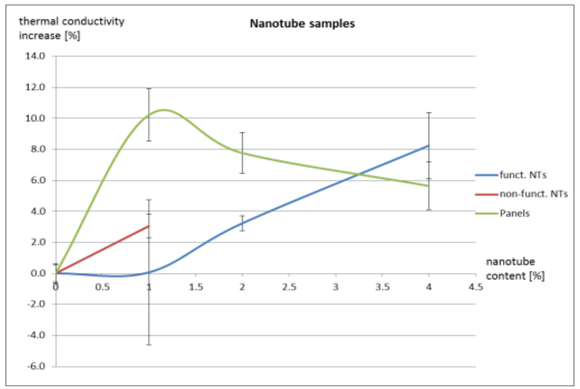
MEASUREMENT TECHNIQUE

- The sample is placed with good thermal contact between the heater bars of known thermal conductivity reference materials.
- The cartridge heater provides the heat that flows through the two heater bars and the sample to the cooling plate.
- Five thermistors measure the temperatures at known positions and with known thermal properties of the reference material (heater bars). Knowing the distances between the thermistors, the heat flux can be calculated.
- The thermal conductivity of the sample is determined knowing the temperature drop over the sample's thickness and the calculated heat flux through the sample.

ADDITION OF MWNTs

- Multi-walled carbon nanotubes were dispersed into epoxy resin by ultrasonication and the influence on the thermal conductivity was determined.
- The effect of nanotube functionalization and content on thermal conductivity and processing was investigated.
- MWNTs were inserted into neat resin and composites with carbon fabrics and their conductivity was measured.

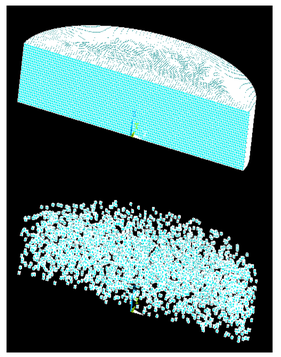
EFFECT OF MWNTs



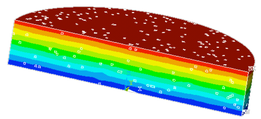
- MWNT doped samples showed just a slight increase in thermal conductivity.

MODEL FOR HEAT TRANSPORT

- A model with randomly arranged nanoparticles was created.



- The model shows an increase of 12% in thermal conductivity which is in line with measured values



FUTURE WORK

- As the effect of inserting MWNTs is not significant, milled pitch fibers will be dispersed into the resin as they also have high conductivity and allow higher filler content.
- Use of 3D-preform with highly conductive pitch-based fibers in z-direction as reinforcement infused with doped resin.

ACKNOWLEDGEMENTS

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