Scott Mayle, J Material Sci Eng 2014, 3:3
http://dx.doi.org/10.4172/2169-0022.S1.015

OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Conference and Exhibition on
Materials Science & Engineering
October 06-08, 2014 Hilton San Antonio Airport, USA

Development of thermometry for carbon nanotube thermal electric cooler

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One of the major challenges with modern electronics and circuitry is the waste heat generative by the system. A proposed solution to this problem is in situ cooling of devices using a thermal electric cooler (TEC). If in situ TECs are to be employed, the cooling efficiency of current devices must be improved. One possible candidate to improve TECs are carbon nanotube (CNT) based devices. However, while fabricating such devices, a diagnostic problem occures. To test the ability for a CNT device to cool, one must have a good local measurement of temperature. Additionally, since it is only the cooling power of the CNT device that is to be measured, the temperature measurement must not heat the system. Finally, due to the applied nature of this system, we need to find thermometry that works in a large range of temperatures (from cryogenic temperatures to room temperatures). A proposed solution to these problems is to use a double barrier tunnel junction as a thermometer. A central piece of metal is placed on top of the TEC and is used to thermalize with the device. The double barrier tunnel junctions are then made to this central piece of metal. The tunnel junctions will allow for least invasive conductance measurements on the central island to determine the temperature, for a large range of temperatures. This poster presents the feasibility of using such a thermometer on a device such as a CNT TEC.

Biography

Scott Mayle is a graduate student at Northwestern University.