A Thermal Interface Material Consisting of Carbon Nanotube and a Brazing Alloy

Pretreating carbon nanotubes enables high-strength brazing for materials, enhancing thermal conductivity and stability in high-temperature applications like thermoelectric modules.

Carbon nanotubes (CNT) are nanomaterials that are being intensely investigated as thermal interface materials due to their high conductivity, but their use has been limited in part due to ineffective methods of bonding them to other materials. This limitation is caused by CNT's instability at high temperatures, so they are generally used in conjunction with soldering, which is performed at lower temperatures. Unfortunately, soldering provides only minimal bonding strength, has low resistance to corrosion, and cannot withstand high temperatures.

Researchers at Purdue University have developed a technique to bond CNTs to other materials using brazing, a much stronger and suitable bonding method than soldering. Like soldering, brazing connects materials using a melted filler alloy, but the brazing alloys melt at much higher temperatures, creating bonds far stronger than those using soldering. In order to withstand the high temperatures of this process, the CNT must first be treated with a process, such as a boron-nitrate treatment, also developed by Purdue researchers. The pretreatment increases the CNT's low wettability with other materials, helping increase the strength of the bond. Brazing can be used to join different layers of thermoelectric modules (TEMs) that operate in high temperatures. The enhanced thermal conductivity and lowered thermal interface resistance of the brazing layer help to maximize the power output of the resulting TEM.

Advantages:

-Greater bond strength

-Increased thermal conductivity and lowered thermal resistance between bonded materials.

Technology ID

2013-FISH-66462

Category

Energy & Power Systems/Power Generation
Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Materials Science & Nanotechnology/Thermal Management Materials & Solutions

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Potential Applications:

-Materials engineering

-Thermoelectrics

TRL: 5

Intellectual Property:

Provisional-Patent, 2015-03-12, United States | Utility Patent, 2016-03-14, United States

Keywords: Carbon nanotubes, CNT, thermal interface materials, brazing, soldering, high conductivity, bonding strength, thermoelectric modules, TEMs, boron-nitrate treatment, nanomaterials, materials engineering, thermo-electrics, Carbon Nanotubes, Materials and Manufacturing, Mechanical Engineering, Nanomaterials, Thermoelectric