

# Thermal Materials & Coolants



## Tackling Today's Thermal Problems

As energy consumption rises around the World so does the need for effective thermal materials and coolants from heat sinks used in personal computers and other electronics to liquid coolants for vehicles and supercomputers. Effective cooling not only lowers energy costs but also improves the performance and useful life of many products. High purity Boron Nitride Nanotubes may be incorporated into a variety of materials to improve the thermal characteristics of both air-cooled and liquid cooled solutions.

### Mechanical Heat Sinks

- ✓ Boron Nitride Nanotubes are effective in transferring heat while remaining stable at very high temperatures.
- ✓ Added to metals and plastics, Boron Nitride Nanotubes improve the thermal capacity of host materials which are designed to transfer heat away from critical components.

### Liquid Coolants

- ✓ The addition of Boron Nitride Nanotubes to liquid coolants improves the thermal capacity of the host liquid.
- ✓ Because of the low electrical conductivity of Boron Nitride Nanotubes, it may be used in non-conductive fluids that come into direct contact with energized electrical and electronic parts.

## Computers & Other Electronics

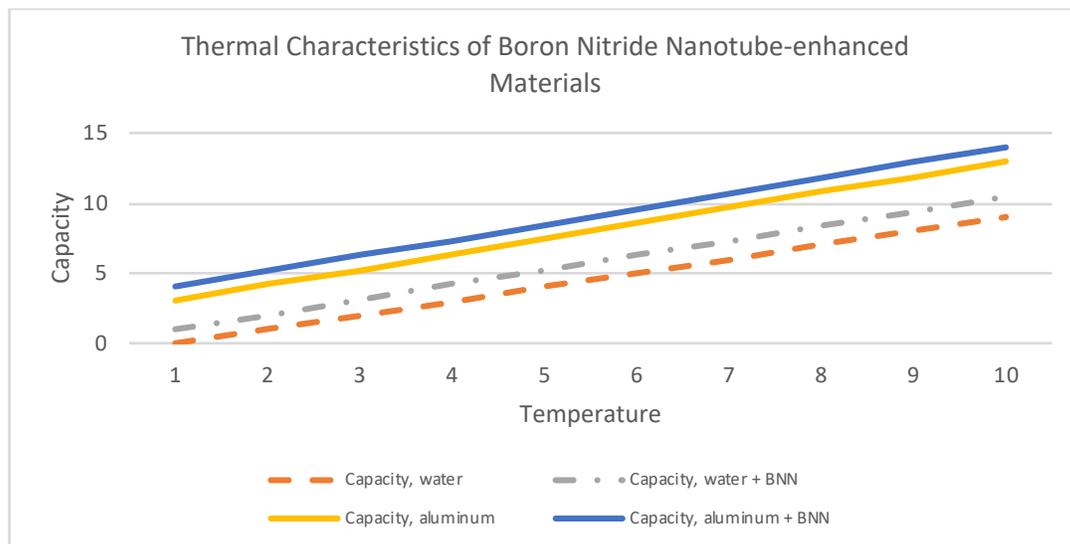
According to Data Center Knowledge, nearly half of the total energy consumed by a modern data center may be due to cooling the rows and rows of servers. While conventional air conditioning has typically been used to keep data centers running, large centers of the type that Google manages, now utilize several layers of cooling technology including heatsinks, non-conductive fluids, and ordinary chilled water.

## Industrial & Medical Lasers

As lasers transform electrical energy into light, heat is generated. Overheated laser systems can suffer from a reduction in the quality and characteristics of the light they emit. Heat can also degrade the key components of the laser and reduce the useful life of the instrument.

## Thermal Capacity Enhancement with BORON NITRIDE NANOTUBES

The graph below shows how Boron Nitride Nanotubes added to metals, plastics and liquids shift the thermal characteristics of the host material. Boron Nitride Nanotubes also improve the strength and stability of the resulting composite. Because Boron Nitride Nanotubes are stable at high temperatures it does not undergo phase change which can impact the thermal properties of materials.



## Nanoscience, Nanotechnology & Nanotubes

Simply put, **nanoscience** and **nanotechnology** are the study and application of extremely small things. Today's materials engineers are designing products at the atomic and molecular level for game-changing results.

**Nanotubes** are small hollow cylinders with diameters of 2 to 20 nanometers and lengths on the order of tens of microns. Individual tubes exhibit extraordinary properties, including high thermal stability and thermal conductivity, electrical resistivity, exceptional strength and stiffness, and super hydrophobicity (resists combining with or dissolving in water).