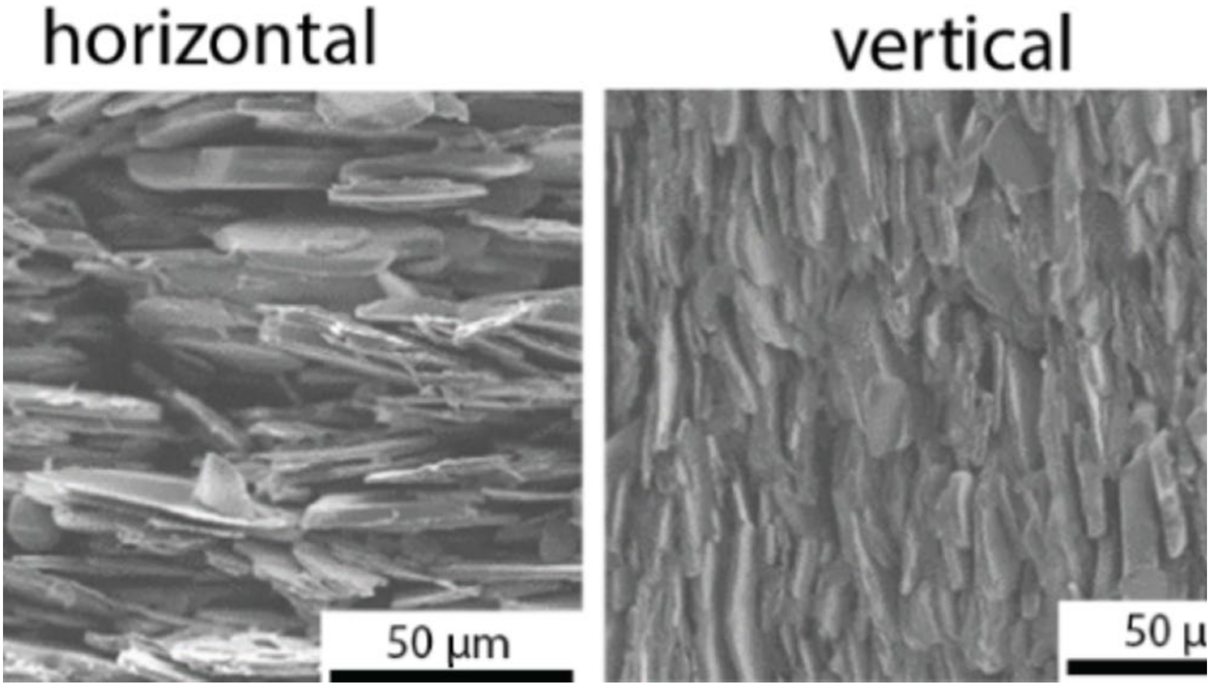
25 Sep 2023

NTU team develops solution to prevent overheating in next-gen electronic devices

Researchers at Nanyang Technological University in Singapore have developed a solution that prevents overheating in the next generation of energy efficient, high-performance 3D-stacked electronic devices.



Microscopic particles of hexagonal boron nitride in various configurations - NTU Singapore

3D-stacked electronics are made of interconnected vertical layers of chips that are prone to overheating because densely packed components prevent heat from escaping.

Now, using magnetic fields to align and orient nanoparticles of hexagonal boron nitride (BN), a team of scientists, led by Nanyang Asst Prof Hortense Le Ferrand of NTU's School of Mechanical and Aerospace Engineering, was able to channel heat away from their sources.

The researchers first coated particles of BN with iron oxide to make them responsive to magnetic fields. They then suspended the coated particles in a solvent and used a magnetic field to align the particles in different orientations.

The scientists tested the ability of the different configurations to dissipate heat and found that vertically arranged particles channelled heat upwards most effectively. The orientation of the particles could also be tailored to direct heat sideways, such as when the particles are sandwiched between two heat-emitting electronic components.

Asst Prof Le Ferrand explained that for heat to be dissipated in specific directions, it should travel in an unbroken chain along the length of the particle and between particles.

“The biggest challenge that we encountered was arranging the BN microplatelets such that heat is channelled efficiently from one particle to another, for example, between the top of one microplatelet and the bottom of the microplatelet above it,” said Asst Prof Le Ferrand. “To do this, we made the BN composites porous and, using our method, we arranged the microplatelets to resemble a house of cards with pockets of air between the particles. This way, the microplatelets are in contact with one another only at certain points. Air is a poor conductor of heat, so heat would be directed to travel along the length of the microplatelet and the edges of the microplatelets that are in direct contact with one another, forming a continuous bridge.”

Asst Prof Le Ferrand continued: “Our method of aligning and orienting BN particles precisely and easily to strategically direct heat away could offer new solutions for effective heat management of high-power electronic devices.”

The team’s findings have been published in Advanced Materials.

https://www.theengineer.co.uk/content/news/ntu-team-develops-solution-to-prevent-overheating-in-next-gen-electronic-devices