Researchers develop faster and cheaper technique to cool electronic systems

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A novel cooling system developed by researchers from the National University of Singapore (NUS) will pave the way for cheaper and more effective thermal control systems. The innovative technique can potentially achieve up to 50 per cent more effectiveness in cooling in electronic systems compared to current cooling systems.

Developed by a research team led by Dr Lee Poh Seng from the Department of Mechanical Engineering at the NUS Faculty of Engineering, the cooling system can be applied to large electronic systems, such as those in defence and transport, as well as everyday electronic devices such as laptops.

Dr Lee and his team showed that the novel technique is more effective in terms of stability and reliability compared to existing systems. It enables electronic systems to be maintained at cooler operating temperatures so that their performance and lifespan can be extended.

It is also more cost effective and reduces energy consumption as the system does not require huge pumps to generate the flow of the coolant. If it is implemented in major set ups such as nuclear plants, the system is capable of transferring a tremendous amount of heat which can be rechanneled as an additional source of energy.

Furthermore, this technique can be applied to electronic systems and devices operating in compact spaces, as it does away with the need for huge and noisy cooling fans which are commonly used in most cooling systems.

The researchers successfully combined the use of two types of heat sinks, which are structural devices built into a system to dissipate heat, known as "microgaps" and "stepped fin microchannels". In the novel cooling system, each microgap, ranging from 80 to 1000 microns, is structured over surfaces to facilitate easy and rapid dissipation of heat which is further enhanced by microchannels.

This two-phase technique is based on the "flow-boiling" concept. First, the liquid coolant flows along the system and enters the microgaps where it picks up heat and reaches boiling point. Next, the coolant converts from the liquid to the vapour state and absorbs the latent heat during this phase change process. For the boiling process to occur, the researchers had to design the surface of the microgaps to ensure that it is of an ideal texture and not too smooth in order to promote the formation of the vapour bubbles.

Said Dr Lee, "We have worked on this technique for two years before we hit on the right set up. For the system to work well, two main factors have to be taken into consideration, the size of the gaps and the texture of the surface of the gaps through which the coolant flows. We spent many long hours monitoring the boiling regime using special high-speed cameras. Through the recorded videos, we managed to extract data for us to design microgaps that are of the optimal size and surface texture to allow the cooling process to take place rapidly and effectively."

The team was awarded a $250,000 Proof-of-Concept grant by the National Research Foundation in February 2013 and will produce a prototype by early next year.

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