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Design and investigation of a pulsating heat pipe (PHP) for electronic cooling

Popular science summary

With the ever-increasing demand for connectivity and the rapid development of technology and electronic manufacturing, products are constantly becoming more compact and increased cooling demands are placed on electronic devices. You might wonder, how can these devices operate efficiently, for long hours, and not get overheated?

This is mainly because electronic devices usually have an internal cooling device, that works to prevent overheating when operating. This is vital since the increase in temperature leads to deteriorating the performance of these products noticeably. There are several types of cooling devices used for electronics, some of the most common ones are heat pipes. Various types of heat pipes exist, and what is known as conventional heat pipes are often integrated into applications for cooling purposes. However, with the increasing cooling demands of the industry, sometimes, conventional heat pipes exhibit limits. For this purpose, pulsating heat pipes (PHPs), seem to be an optimal solution. They are called pulsating heat pipes because when they operate, an internal fluid, which is filled in the heat pipe before operation, moves in a pulsating motion . For a PHP to function, heat needs to be supplied to it and the pipe must be designed in a specific way. It can bring several advantages when compared to other methods used for cooling because the geometry is very simple, as it`s only made of several tubes, additionally, no external device is needed to assist the operation of the pipe. Generally, pulsating heat pipes have very small tube sizes, as this is required for them to function properly, making it also easier to integrate into compact electronics, with production costs that can be reduced.

Pulsating heat pipes are not commercially available yet and a lot is not known about how these pipes function. This thesis aimed to design and build a demonstrator pulsating heat pipe, in addition to test how it performed when varying certain parameters, to better understand the device operation. Finally, the demonstrator was built in glass, this made it possible to capture some images of the fluid and see how it moves inside, which could help improve understanding on the topic.

Pulsating heat pipes are promising cooling devices, which could potentially solve some limits that the industry is facing . However, a lot has to be understood about these devices before being able to have them commercially available, making them an intriguing topic for further research.