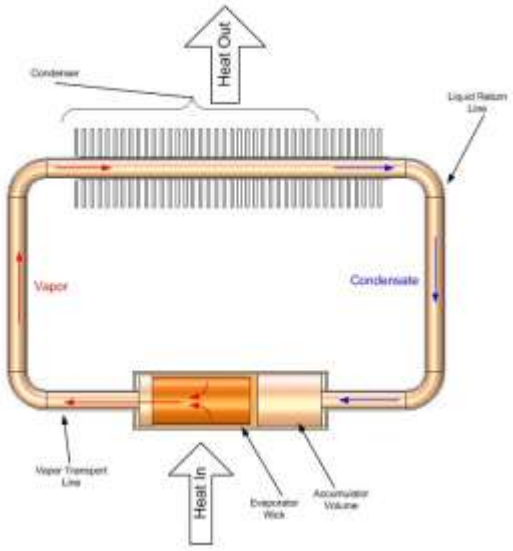
Miniature loop heat pipes for cooling high heat flux devices

The miniaturization and rapidly increasing heat loads of the new electronic devices put forward the challenge of efficient cooling in these devices. This is because of the high heat flux produced by ultra large scale of integration of electronic components into these devices. The present electronic components are very compact in size and the area available for heat dissipation in these devices is very less. The high heat fluxes in miniaturized electronic devices produce thermal stresses which reduce the reliability of these devices. Similarly, the life of electronic components also decreases as their operating temperature increases. Nowadays, miniaturization of electronic devices is the trend. The growing trend of miniaturization increases the heat produced which is comparable with the quantity of heat from a nuclear reactor or surface of the sun on a unit volume basis. The road map of the International Electronics Manufacturing Initiative predicts a maximum heat dissipation of 360W from a high performance microprocessor by 2020.

Use of typical air cooling or liquid cooling is not sufficient to meet the cooling demands of present and future miniaturized electronic devices. Because, the conventional cooling systems have low convective heat transfer coefficients and the thermal conductivity of coolants used in them has low values. It indicates that cooling is still a challenge that needs to be addressed in many electronic applications. So an effective cooling system with advanced heat transfer fluid has to be developed to meet the current cooling requirements. Moreover, the packaging limitations of the small electronic devices make this problem more complicated. An effective cooling method capable of keeping the temperature of the electronic devices within their safe operating limits and satisfying the compact packaging constraints can only solve this problem.

Miniature loop heat pipes (mLHP) are capable of transferring large amounts of heat to significant distance with no pumping power because they utilize boiling and condensation phenomena. The other advantages of mLHPs include electricity free operation, ability to work with small temperature difference, compact size and reliability. This technology has been developed in the Centre for Research in Material Science and Thermal Management (CRMSTM) available in the Department of Mechanical and Aerospace Engineering of Karunya Institute of technology and Sciences. A novel miniature loop heat pipe is designed and demonstrated for

cooling the high-end central processing units, graphic processing units, integrated bipolar transistors, circuit breaker in low voltage switch board etc. using the research fund received from the Department of Science and Technology, Government of India.



Miniature Loop Heat Pipe