Public Abstract
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A mathematical model is developed to predict the refrigeration performance of an ejector powered by waste energy from a thermoelectric cooler. The model is based on constant pressure mixing process and considers the effect of frictional loss, viscous effect and shock wave phenomenon. Using this model, effects of nozzle exit position, temperatures of low and high temperature evaporators, area ratios, and working fluid on the system performance can be predicted.

The components of the ejector were fabricated and an experiment was set up using water as working fluid. At steady state, effects such as operational conditions, nozzle exit position and critical condensing pressure on performance of the system were studied. The experimental results were compared with investigations conducted by other researchers and also with theoretical prediction. Based on the experimental results and theoretical prediction, the performance of a miniature thermoelectric ejector cooler can be determined.

While a pump is needed for a conventional ejector cooling system, the investigated system is to utilize the capillary force generated by thermal energy to produce the pumping capability to pump the working fluid from the condenser to both low-temperature evaporator and high-temperature evaporator. A mathematical model is developed to predict the capillary flow and ensure the circulation through the entire system from the condenser, through the low-temperature evaporator to the high-temperature evaporator. The model can consider the effects of wick structure, vapor pressure, liquid pressure, temperature and flow rate. Using this model, the hybrid ejector system is designed and fabricated. The experimental system to test the prototype is developed and an experiment is conducted subsequently. Using the waste energy generated from the hot side of the thermoelectric cooler, the coefficient of performance (COP) of the hybrid system, i.e., thermoelectric cooler integrated with ejector refrigeration system, can be highly increased. The investigation will result in highly efficient cooling system for electronic cooling.