TWO-PHASE FLOW DYNAMICS BY REAL-TIME NEUTRON IMAGING IN OSCILLATING HEAT PIPE

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ABSTRACT

Neutron imaging can produce unique images of objects making it a useful non-destructive technique with various applications in science and industry. Oscillating heat pipes (OHP) are being studied as a higher performance way of cooling high power electronics. They have shown better performance than conventional heat pipes, but little is known about the dynamics of the liquid and vapor inside the OHP. In these studies, the dynamics of liquid and vapor were studied by calculating the liquid and vapor volume fractions in different sections of the OHPs using neutron imaging and the resulting data were compared with external temperature data to investigate the workings of the OHPs. The results show that neutron imaging is a useful technique to quantify the dynamics of the vapor and liquid in OHPs. Imaging shows that at lower heat fluxes water does not circulate around the heat pipe as it does at higher heat fluxes. Instead, the evaporator, where heat is input, is largely vapor with only very short entrances of liquid. In contrast, acetone circulates around the heat pipe at lower heat input as well as at higher heat input. The acetone-OHP shows better performance than a water-OHP due to more active liquid movement. It is inferred that viscosity and density affect the performance of OHP. Temporal volume fraction data corresponds well with temperature data. In contrast, individual temporal volume fraction data does not show as good a correspondence with individual temperature at each thermocouple position.