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A MOLECULAR DYNAMICS STUDY OF PASSIVE HEAT FLUX ENHANCEMENT IN BOILING LIQUID ARGON

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ABSTRACT Molecular dynamics simulations were employed to investigate the pool boiling heat transfer of a liquid argon thin film on a copper substrate. The aim of the study was to determine the efficacy of passive techniques for enhancing overall heat flux. Simulations were run using a patterned wall structured with copper nano-pillars. For the nano-structured wall, three different scenarios were considered: 1) an argon-philic wall of argon-philic pillar arrangement, 2) an argon-philic wall with argon-phobic pillar arrangement, and 3) argon-phobic wall with an argon-philic pillar arrangement. The solid copper wall is five atom-layers thick, while the nano-pillars were nine atom-layers thick. The argon liquid was laid on top of the solid wall and had a thickness greater than that of the nano-pillars. The remainder of the simulation box was populated with argon vapor particles. Once the solid, liquid, vapor system was equilibrated near argon's boiling point temperature, the copper wall was suddenly heated to a higher temperature and allowed to interact with the argon atoms. Two superheats were used, one near the boiling temperature to induce normal 'nucleate' boiling, and the other far above the boiling temperature to induce explosive boiling. Results indicate that the argon-phobic/philic patterning acts to increase overall heat flux, with the argon-phobic nano-pillar/argon-philic wall showing the best performance.