表面微細構造及び濡れ性がエタノールの沸騰伝熱に及ぼす影響

Effects of surface microstructure and wettability on boiling heat transfer of ethanol

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1. Introduction

Enhancement of boiling efficiency of low-boiling-point coolants is of vital importance to efficient thermal management of electronic devices, which conventionally relies on engineered surface topography¹. In this study, we sought to improve saturated boiling of ethanol by adopting a hybrid approach of surface porous texturing and wettability patterning.

2. Experimental results

Several boiling surfaces were used in the ethanol boiling experiments, including a plain aluminum surface (AL), a phosphoric-acid anodized surface (PAA), and a sulfuric-acid anodized surface (SAA). The average pore sizes on the PAA and SAA surfaces were around 200 nm and 20 nm, respectively. Using a novel amphiphobic coating consisting of fluoropolymer halloysite nanotubes², a *biphilic* (97°/0°) pattern—with Ø2-mm hydrophobic spots planted at a 5.5-mm interval—was added on the porous surfaces (denoted PAA-bi and SAA-bi surfaces). The results show that nucleate boiling commenced on the hybrid surfaces at consistently low superheats (see Fig. 1) between two consecutive experimental runs (named ‘dry’ and ‘wet’, respectively) while retaining most of the enlarged heat transfer rate achieved on the porous-textured surfaces (Fig. 2).

Fig. 1 Comparison of insipient boiling superheats ΔT_{omb} .

Fig. 2 Comparison of the heat transfer coefficient h obtained at a heat flux level around $q=250$ kW/m².

References

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