

# LEIDENFROST FILM STABILITY AND THERMAL HYDRODYNAMIC RESPONSE OF ALUMINIUM SURFACES MODIFIED BY SURFACE TEXTURING AND HYDROPHOBIC FUNCTIONALIZATION

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In maritime transportation, hydrodynamic drag is a primary determinant of vessel energy efficiency, net power consumption, and operating costs. A substantial fraction of fuel is expended to overcome frictional resistance at the hull water interface, leading to significant energy losses that must be mitigated. Consequently, extensive research has focused on strategies for drag reduction and energy savings. Among these, surface modification by functional coatings is regarded as a promising approach for reducing frictional drag. Hydrophobic and superhydrophobic surfaces reduce liquid–solid interaction by repelling water, thereby decreasing skin friction resistance along the hull. This study investigates the influence of low surface energy coatings on reducing the Leidenfrost temperature and enhancing friction reduction, using stearic acid (SA) and octadecyltrichlorosilane (OTS) as representative surface functionalization agents. Aluminium substrates were initially cleaned with isopropanol, followed by chemical texturing via immersion in NaOH solutions (2.5 and 7.5 g L<sup>-1</sup>) for 1 h at 100 °C. Subsequently, the samples were functionalized with SA and OTS to evaluate how different coating methodologies affect the Leidenfrost temperature and hydrodynamic performance. Leidenfrost behavior was examined under pool boiling conditions by immersing the heated samples into a water bath maintained at 20 °C. Sample surface temperatures prior to immersion were set to 200 °C, 250 °C, 300 °C, and 400 °C. After identifying the Leidenfrost temperature, friction-related performance was quantified by measuring the time required for each sample to travel a fixed vertical distance of 1.87 m, from which the falling velocity was calculated using  $v=d/t$ . The results indicate that effective friction reduction is associated with the formation of a stable vapor layer at the solid liquid interface. This effect is more pronounced for OTS-functionalized surfaces than for those coated with stearic acid, indicating superior vapor-film stability and enhanced drag-reduction performance for OTS treated aluminium surfaces.