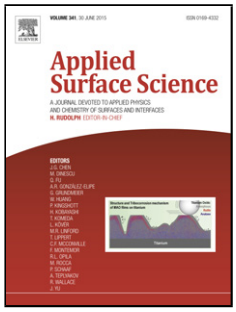

Title: Drag reduction using metallic engineered surfaces with highly ordered hierarchical topographies: nanostructures on micro-riblets

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Title Drag reduction using metallic engineered surfaces with highly ordered hierarchical topographies: nanostructures on micro-riblets

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Abstract

Durable drag-reduction surfaces have recently received much attention, due to energy-saving and power-consumption issues associated with harsh environment applications, such as those experienced by piping infrastructure, ships, aviation, underwater vehicles, and high-speed ground vehicles. In this study, a durable, metallic surface with highly ordered hierarchical structures was used to enhance drag-reduction properties, by combining two passive drag-reduction strategies: an air-layer effect induced by nanostructures and secondary vortex generation by micro-riblet structures. The nanostructures and micro-riblet structures were designed to increase slip length. The top-down fabrication method used to form the metallic hierarchical structures combined laser interference lithography, photolithography, thermal reflow, nanoimprinting, and pulse-reverse-current electrochemical deposition. The surfaces were formed from nickel, which has high hardness and corrosion resistance, making it suitable for use in harsh environments. The drag-reduction properties of various metal surfaces were investigated based on the surface structure: a bare surface, a nanostructured surface, a