Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Effects of Hydrostatic Pressure on the Drag Reduction of Submerged Aerogel-Particle Coatings MOHAMED GAD-EL-HAK, HOOMAN VAHEDI TAFRESHI, MOHAMED A. SAMAHA, Department of Mechanical & Nuclear Engineering, Virginia Commonwealth University, Richmond, VA 23284 — Hydrophobic aerogel particles with different average diameters are randomly deposited onto metallic substrates with a thin adhesive coating to achieve a combination of hydrophobicity and surface roughness. The resulting surfaces show different degrees of superhydrophobicity and are used to study the effects of elevated pressure on the drag reduction and the degree of hydrophobicity (sustainability) of such surfaces when used for underwater applications. We also developed an image-thresholding technique to estimate the gas area fraction of the coating. The results indicate that there exists a new parameter, the terminal pressure, beyond which the surface undergoes a global transition from the Cassie state to the Wenzel state, and therefore can no longer generate drag reduction. This terminal pressure differs from the previously identified critical pressure. The latter is the pressure above which the surface starts the transition process at some location, but not necessarily at other spots due to the heterogeneity of the surface. For the particle coatings used herein, the terminal pressures are measured to range from 100 to 600 kPa, indicating that such coatings could potentially be used for deep underwater applications.

Mohamed Gad-el-Hak
Virginia Commonwealth University

Date submitted: 06 Jun 2012 Electronic form version 1.4