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Superhydrophobic Surfaces for Extreme Environmental Conditions[1] HENRY LAMBLEY, THOMAS SCHUTZIUS, DIMOS POULIKAKOS, ETH Zurich — Superhydrophobicity against impinging water droplets predominantly relies on designing surfaces with capillary pressures larger than that of the impinging droplets. More recent research has explored the compression and drainage of the air layer beneath an impacting droplet and how this can enhance impalement thorough local droplet deformation and increases in the local curvature. However, comparatively little consideration has been given to how the both the thermodynamic state and composition of the intervening gas layer, as well as compressibility effects, affect the outcome of impacts when departing from ambient conditions. Here, by varying the ambient pressure and relative humidity, we probe the limits of the working envelope for robust superhydrophobic surfaces and explore the different failure mechanisms exhibited beyond this. Using engineered materials synthesised with a variety of micro and nanoscale features, we are able to propose additional design constraints to mitigate against this and provide superhydrophobic and icephobic solutions for applications spanning a broad range of environmental conditions.

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