Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Effect of vapor pressure on the performance of a Leidenfrost engine PRASHANT AGRAWAL, GARY WELLS, RODRIGO LEDESMA-AGUILAR, GLEN MCHALE, Northumbria University, ANTHONY BUCHOUX, KHELLIL SEFIANE, ADAM STOKES, ANTHONY WALTON, JONATHAN TERRY, The University of Edinburgh — Friction is a hindrance to effective mechanical energy conversion, especially at microscales where significant wear occurs due to a high surface-area to volume ratio. Recently, we have developed the concept of a virtually frictionless heat engine, employing levitating liquids (or solids) on turbine-inspired substrates to convert thermal energy to mechanical motion. The levitation is achieved via the Leidenfrost effect, where a liquid drop levitates on its own vapor when it contacts a substrate heated to temperatures significantly above the liquid's boiling point. The vapor layer virtually eliminates friction and allows evaporating drops to self-propel on asymmetrically textured substrates. In this work, we operate this Leidenfrost heat engine continuously and control its output power by mechanically altering the vapor layer thickness. This is done by replenishing the liquid and supporting the rotor using a bearing assembly. We observe an increase in the power output despite the added bearing friction. The design principles described here can be extrapolated to develop mm and sub-mm scale engines for applications in extreme environments with naturally occurring low pressures and high temperature differences. We acknowledge funding from UK EPSRC (EP/P005896/1 and EP/P005705/1)

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Date submitted: 31 Jul 2019 Electronic form version 1.4