The Journal of the Acoustical Society of America

Free • Published Online: 10 May 2022

Quiet power: Exploring the feasibility of a noise-mitigating, thermoacoustic energy harvester

The Journal of the Acoustical Society of America **151**, A179 (2022); https://doi.org/10.1121/10.0011025

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Meeting abstract. No PDF available.

ABSTRACT

The thermoacoustic effect provides a means to convert acoustic energy to heat and vice versa without the need for moving parts. This enables the realization of mechanically robust, noise mitigating energy harvesters, although there are limitations to the power-to-volume ratio achievable. The mechanical, thermal, and geometric properties of the porous stack that forms a set of acoustic waveguides in thermoacoustic devices are key to its performance. In this feasibility study, first, various 4-in. diameter ceramic and polymeric stack designs are evaluated using a custom-built thermoacoustic test rig. Influence of stack parameters such as material, length, location, porosity, and pore geometry are correlated to simulations using DeltaEC, a software tool based on Rott's linear approximation. An acousto-thermo-electric transduction scheme is employed to harvest useable electrical power using the best performing stack. Steady-state peak voltage generated was 33.5 mV for a temperature difference of 34 °C between thehot and cold sides of the stack at an acoustic excitation frequency of 117.5 Hz. Further investigations are underway to establish structure-

performance relationships by extracting scaling laws for power-to-volume ratio and frequency-thermal gradient dependencies.