

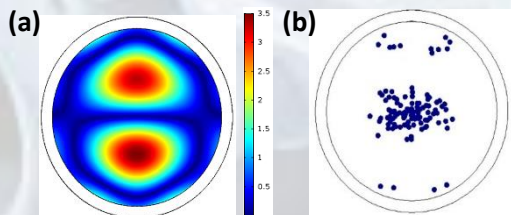
# ACOUSTIC NOZZLE FOR ADDITIVE MANUFACTURING

## Technology Overview

In the nozzle, distribution of multiphase material (solid particles/cells suspended in liquid) is random. Thus, it is a limitation of AM to precisely locate or focus microparticles/cells in the printing structure. Focusing microparticles in the 3D printed structure could potentially improve the load distribution, mechanical performance and functionality. By using this acoustic nozzle, microparticles/cells could be patterned in the nozzle and subsequently in printing structure. The indirect benefit of this is to suppress clogging of the nozzle as well.

## Potential Applications

This acoustic nozzle could be applied to multiphase material using nozzle-based AM (e.g. circuit and bioprinter). For bioprinting, accumulation of biological cells in 3D construct provides better cell proliferation and differentiation. For circuit printing, accumulation of conductive particles also results in a greater electrical performance for 3D printed electronic parts.

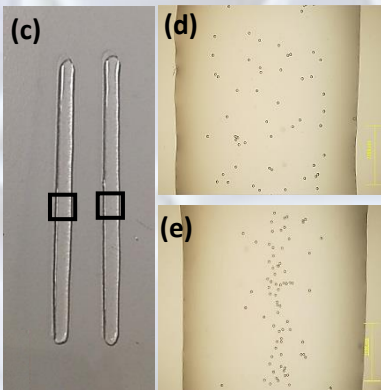


## Features & Specifications

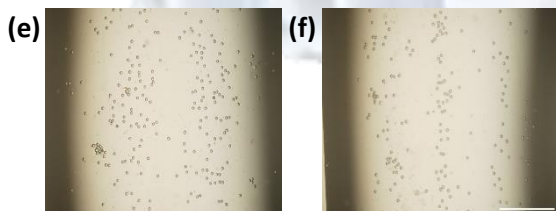
The main feature of this technology is to manipulate microparticles/cells within the nozzle. Subsequently, the microparticles/cells are patterned in the 3D printed constructed. Microparticles/cells could be formed in various patterns by excitation frequency. The indirect advantage is to arrange microparticles/cells orderly in the nozzle which reduces the chance of deposition and clogging at the constriction area of the nozzle.

## Customer Benefits

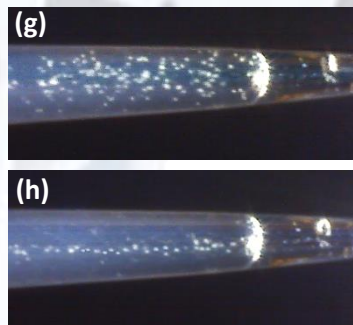
- Enable patterning of microparticles/cells in the 3D printing constructed
- Pattern could be varied by switching the excitation frequency
- Versatile, this acoustic nozzle could be applied to multiphase material in nozzle-based 3D printers
- Nozzle clogging issue could be suppressed
- The acoustic nozzle could be installed and operated with ease



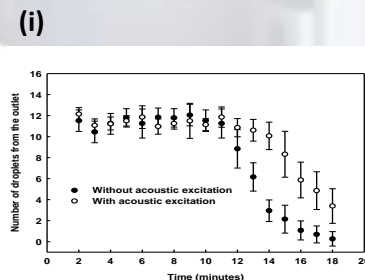
(c) Hydrogel printed construct with 0.5% microparticles, (d) without excitation, and (e) with excitation



Microparticles distribution in the printing structure with higher frequencies (e)  $f_2$  and (f)  $f_3$



Microparticles orientation in the nozzle (g) without and (h) with frequency excitation. And (i) medium discharge over time from the nozzle



If you are interested in this technology, please contact the BD Manager: [edmund.lim@ntu.edu.sg](mailto:edmund.lim@ntu.edu.sg)