Supporting information

Direct 3D Printing of Piezoelectrets: Process Feasibility, Prototypes Fabrication and Device Performance

Xiaolin Wang¹,², Zhe Liu¹,², Hui Wang¹,², Changchun Zeng¹,²

¹Department of Industrial and Manufacturing, FAMU-FSU College of Engineering
²High-Performance Materials Institute, Florida State University
Tallahassee, FL 32310, USA
Correspondence to: Changchun Zeng (zeng@eng.famu.fsu.edu)
Fig. S1. Photograph and crack/surface ratio of the piezoelectric foams fabricated under different conditions. The default printing parameters are 190°C, 30mm/s, 0.2mm layer height and 120% flow rate. From (a₁)-(a₃), the samples are printed in 190°C, 210°C and 230°C, respectively; from (b₁)-(b₃), the samples are printed in 10, 30 and 50mm/s, respectively; from (c₁)-(c₃), the samples are printed with 0.1, 0.2 and 0.3 mm layer height, respectively; from (d₁)-(d₃), the samples are printed with 100%, 110% and 120% flow rate, respectively.
Fig. S2. Photograph of the piezoelectret sensor demo system

Derivation of Equation (9)

Equation (9) was derived as the following. In the extrusion process, the material was first extruded from the nozzle and the extrudate was then dragged by the nozzle to finish the printing. In a unit time $t$, the material extruded out can be expressed as:

$$V_{\text{extrude}} = \frac{\pi D^3 v_1 t}{4}$$

Where $D$ is the nozzle diameter, $v_1$ is the extrusion speed.

If the shape of the printed filament is assumed to be rectangular, the amount of the extrudate used for printing can be expressed as

$$V_{\text{print}} = wh v_2 t$$

Where $w$ is the filament width, $h$ is the layer height and $v_2$ is the printing speed.

The amount of the materials extruded from the nozzle should be the same amount of the material used for printing. Thus we get equation (9).

$$V = \frac{\pi D^3 v_1 t}{4} = wh v_2 t$$