Piezoelectric Buzzer Optimization for Micropumps

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Abstract

The piezoelectric ceramic has the ability to deform in the direction of polarization, when subjected to voltage between its terminals (Figure 1b) [1].Piezoelectric buzzers are low cost devices which can be used successfully as actuators in diaphragm-based micro-pumps. The buzzers are piezoelectric wafers (lead-zirconate-titanate-PZT) that are glued into a brass membrane (Figure 1a), and they are available within different sizes and thicknesses. For the best performance of a diaphragm pump, it is necessary to have a greater displacement of the membrane and consequently the volume below it [2], nevertheless, this may mean a difficulty in the project because a small variation in dimensional actuator can significantly affect the displacement of the buzzer. The distances between the centers of the membrane of brass and PZT ceramics (de) also affect the displacement of the actuator (Figure 2). Numerical investigations of an optimum value for the buzzer in relation to the brass and PZT ceramic thickness have been developed, in accordance with the membrane size of the micro-pump and in order to have a maximum buzzer displacement. The simulation model has been developed using 3D geometry and the microscale electro-mechanical systems MEMS Module in COMSOL. Through LiveLink™ for MATLAB® [3], parametric variations for the buzzer length and thickness have been made, as well as its maximum displacement has been determined.

Reference

1. LI, S.; CHEN, S. Analytical analysis of a circular pzt actuator for valveless micropumps. Sensors and Actuators A: Physical, v. 104, n. 2, p. 151-161, 2003.
2. Yamahata, C. et al. PMMA valveless micropump using electromagnetic actuation. Microfluidics and Nanofluidics, v. 1, p. 197–207, 2005
3. www.comsol.com

Figures used in the abstract

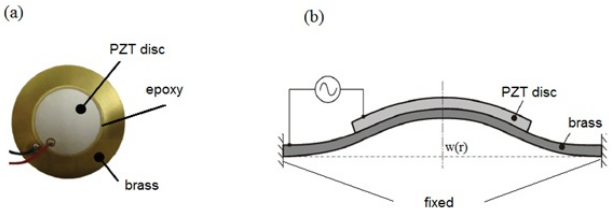

Figure 1: (a)-Buzzer PZT, (b) displacement buzzer-PZT

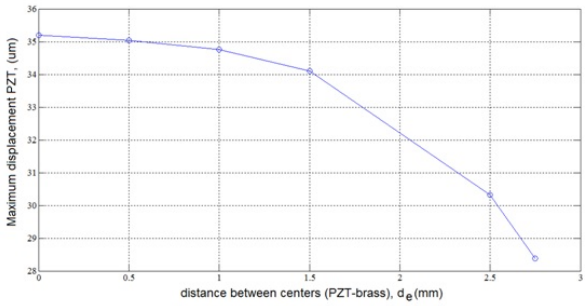

Figure 2: Maximum displacement x distance between center (de)