P 03

Optimised properties of high frequency transducers based on curved piezoelectric thick films obtained by pad printing process

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An original fabrication process to obtain an integrated structure involving a curved piezoelectric thick film is first briefly recalled. This multilayer structure was designed to minimize the fabrication steps of a high frequency single element transducer, in particular to avoid the addition of an acoustical lens to focus the transducer's acoustic beam. On the basis of previous work carried out in order to choose the material of each layer, and in particular a curved substrate of porous PZT directly used as the backing (with a radius of curvature of around 10 mm), a pad-printing process was developed and used to deposit several layers of PZT paste to obtain a curved PZT thick film. The corresponding effective thickness coupling factor was 47% which is similar to that of standard bulk PZT ceramics.

In this work, in order to optimise the properties of high frequency single element transducers based on these multilayer structures, the influence of several parameters were studied and 15 samples were fabricated. The thickness of the gold bottom electrode was varied (few µm), the diameter of the top electrode was decreased from 3.1 to 1.6 mm, and a thickness of the piezoelectric thick film ranging from 15 to 30 µm was used. The results obtained are discussed and a transducer showing a central resonant frequency of 44 MHz is described.

An optimised transducer was characterized using an adapted laser interferometer and a high-frequency hydrophone to measure the displacement at the centre of the top electrode and the radiation pattern. An axial and lateral resolution of 40 µm and 230µm were obtained, respectively.

Finally, the transducer's vibration and its radiation in the surrounding media were successfully modeled using an accurate FD-PSTD algorithm adapted to axisymmetrical configurations [1].

1. E. Filoux *et al.*, IEEE Trans. on Ultras., Ferro. and Freq. Contr., 57(5), pp. 1188-1199, 2010.