LTCC Electromechanical Devices Based on PZT Thick Film Technology

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ABSTRACT

PZT (Lead Zirconate Titanate) thick film technology has been applied successfully in various applications including medical imaging, vibration sensing and energy harvesting. The portfolio of compatible substrates embracing: silicon, stainless steel, alumina has been recently extended by including Low Temperature Cofired Ceramic (LTCC). LTCC technology has been around for many years and has been successfully used in a number of microsystem applications.

Very often the required functionality of a microsystem involves electro-mechanical coupling, for example: microvalve or micro-pump actuation. Recently a new solution has been proposed involving integrated screen printed PZT thick films developed and offered by InSensor A/S. The PZT thick films are of good quality, stable and exhibit repeatable properties. The well known problem of chemical incompatibility has been overcome by applying special processing of the thick films and an effective barrier layer.

In this article three different test devices are studied: a cantilever, a membrane and a thickness mode high frequency transducer manufactured using PZT thick films. The test devices are of a generic structure and can therefore easily be tailored to a particular application. Moreover the piezoelectric cantilever structures are used to estimate the properties of the PZT film.

The presented work has demonstrated that piezoelectric thick films can be successfully integrated into LTCC devices offering a variety of solutions and the tested structures can be easily tailored to fit a number of different applications, e.g.: microsystems, integrated sensors, actuators and even multi-element acoustic transducers. Furthermore, a method of enhancing the piezoelectric response on LTCC substrates is demonstrated giving over three fold increase in the d_{31} coefficient.