

# **PZT thick films for integrated devices – technology and applications**

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## **ABSTRACT**

The development of small and integrated devices requires new and improved manufacturing processes. The screen-printing process is quite well suited for miniaturised and integrated devices, since thick film based structures can be fabricated without the need for further machining. However, the process of screen printed PZT (Lead Zirconate Titanate) thick films involves potential problems of thermal matching and chemical compatibility at the processing temperatures between the functional film, the substrate and the electrodes. In order to solve these problems, a compromise between the lowering of the sintering temperature (down to 850°C) and the conservation of the properties has to be made.

PZT thick film technology developed by Ferroperm/InSensor has been already successfully applied in various applications including acoustic transducers, integrated sensors and actuators. The portfolio of compatible substrates includes Silicon, ceramics, stainless steel and LTCC (Low Temperature Cofired Ceramics). The change in properties often seen in PZT thick-film in this case is mainly due to the physical presence of the substrate and the electrodes, as opposed to chemical reactions between the film and the substrate occurring for many other compositions.

An introduction to the technology of screen- and pad- printed PZT thick films are presented in this paper. Moreover, the basic differences between the traditional bulk ceramic and thick film are discussed. Main properties of the TF2100 material on a variety of substrates are presented together with an introduction to the characterisation methods that are often used in case of the PZT thick film technology. Furthermore, brief overview of the existing applications is given in the paper. This includes focused high frequency acoustic transducers, MEMS accelerometers, piezoelectric transformers, bending actuators, and recently developed integrated energy harvesting devices. It must be emphasised that due to the unique properties of this technology the area of applications is virtually unlimited.