Porous piezoceramics for medical and sensor applications

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The use of porosity for modifying the functional properties of piezoelectric ceramics is well known in the scientific literature as well as by the industry, and the porous ceramic can be seen as a 2-phase composite. In the present work, examples are given of applications where controlled porosity is exploited in order to optimise dielectric, piezoelectric and acoustic properties of the piezoceramics. For the optimisation effort it is important to note that the thickness coupling coefficient k_t will show a maximum for some non-zero value of the porosity that could be above 20 %[1]. On the other hand, with a good approximation the acoustic velocity decreases linearly with increasing porosity, which is obviously also the case for the density, and consequently the acoustic impedance shows a rather strong decrease with porosity. For example, a porosity of 30 % causes the acoustic impedance to drop to approximately 15 MRayl, which should be compared with a value of 33 MRayl for standard Ferroperm^{TM} Pz27 with about 4 % porosity. The significance of the acoustic impedance is associated with the transmission of acoustic signals through the interface between the piezoceramic and some medium of propagation, but when the porous ceramic is used as a substrate for a piezoceramic thick film, the attenuation coefficient may be equally important. In case of open porosity it is possible to introduce a liquid into the pores, and examples of modifying the properties in this way are given.

1. Measurements of the thermal, dielectric, piezoelectric, pyroelectric and elastic properties of porous PZT samples, Lang SB and Ringgaard E, *Appl.Phys.* A, 117, 631-638 (2012).