Lead-free flexible piezoelectric materials for medical applications

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Flexible piezoelectric materials become increasingly popular nowadays and find applications in various areas, including medical applications and smart textile applications, allowing e.g. incorporation of built-in technological elements into everyday textiles and clothes. Recently, a new flexible piezoelectric material, PiezoPaint™, that is compatible with flexible substrates, including textiles, polymers, plastics, paper and requires very low processing temperature (< 100 °C) has been developed and commercialized by MEGGITT A/S. PiezoPaint™ represents a composite material that consists of an organic vehicle (polymer matrix) and a piezoelectric powder, manufactured on the basis of commercially available PZT-based piezoceramics. It is compatible with most of the commercial printing techniques available, including pad-, screen-, and stencil printing techniques.

Medical applications is the fastest growing market for the PiezoPaint™ technology, specifically for applications in the field of medical ultrasound, including smart bandage (with active elements, helping the healing of wounds and/or penetration of medicine into wounds) active monitoring underwear etc. However, the high toxicity of lead and problems with the recycling and disposal of lead-containing piezoelectric devices has inspired extensive investigation of the lead-free piezoelectric materials in general and flexible low temperature piezoelectric materials in particular.

The present work is devoted to the development of lead-free flexible piezoelectric materials on the basis of PiezoPaint™ technology specifically for medical applications, including disposable products. A number of lead-free alternatives to PZT have been considered, including modified KNN-family materials. The first results have demonstrated a suitability of PiezoPaint™ technology for the case of lead-free alternatives of PZT, showing acceptable piezoelectric performance (piezoelectric charge coefficient d_{33} is at the level of 25 pC/N for KNN-based PiezoPaint™ material). Since modified KNN-family piezoelectric materials (bulk) are undergoing intensive development, one can also expect better performance of KNN-based PiezoPaint™ material in the future.