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Elektrische Ermüdung in Funktionswerkstoffen

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Piezoelectric PMN-PZT Single Crystals and Single Crystal-Epoxy Composites for Energy Harvesting Application

Crystallographically engineered relaxor-PT and relaxor-PZT single crystals, specifically PMN-PT and PMN-PZT, offer much higher piezoelectric and electromechanical coupling coefficients (33 mode: d_{33} > 1,500 pC/N, k_{33} > 0.9; 31 mode: d_{32} > 1,500 pC/N, k_{32} > 0.9), when compared to PZT ceramics. So there have been many investigations for applications of piezoelectric single crystals and single crystal composites in the fields of medical ultrasound transducers, naval underwater sonars, actuators, and energy harvesting, etc.

In this presentation the recent developments and applications of PMN-PT and PMN-PZT single crystals will be reviewed. Several kinds of PMN-PT and PMN-PZT single crystals with different Tc, Trt, Ec, and Qm were fabricated by using the solid-state single crystal growth (SSCG) technique. The dopant engineering was also used to make PMN-PT and PMN-PZT single crystals piezoelectrically softer as well as harder. The addition of Mn was found to increase their mechanical Q (up to 1,000) comparable to PZT-8. And single crystal-epoxy composites of 1-3 and 2-2 types were also fabricated by using PMN-PZT single crystals. Their dielectric and piezoelectric properties, the temperature dependence of the piezoelectric/electromechanical properties, and the ferroelectric fatigue effect were characterized for piezoelectric applications such as piezoelectric energy harvesting.

Piezoelectric cantilevers of unimorph structure, which consisted of a single crystal plate and a metal plate, were made for study of piezoelectric energy harvesting. The effects of crystallographic orientation, vibration mode (33, 31, and 15 mode), mechanical quality factor (Qm), and metal plates on piezoelectric energy harvesting were analyzed by using ATILA simulation. The electric power generations from single crystal and single crystal-epoxy composite cantilevers were also measured and compared with those of PZT ceramics cantilevers. From the experimental results, the electric power generations from single crystal cantilevers varied significantly with crystallographic orientation and were more than 20 times than those from PZT ceramics cantilevers. These results clearly demonstrate that the efficiency of piezoelectric energy harvesting can be improved significantly by using high performance piezoelectric single crystals and single crystal-epoxy composites.

Die Vortrag findet um **16:15 Uhr** im Gebäude der Materialwissenschaften, Lichtwiese, Petersenstr. 23, **Raum 77** statt