Piezoelectric Ceramics for Vibrational Energy Harvesting

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Energy harvesting is a field of research that has attracted considerable interest for more than a decade. It can be defined as the technology of devices that transform low-grade energy such as solar energy, vibrations, thermal energy and weak electromagnetic fields into usable electrical energy. Energy harvesting is a key enabling technology for modern wireless sensors where avoiding a battery is either crucial or gives an important competitive edge.

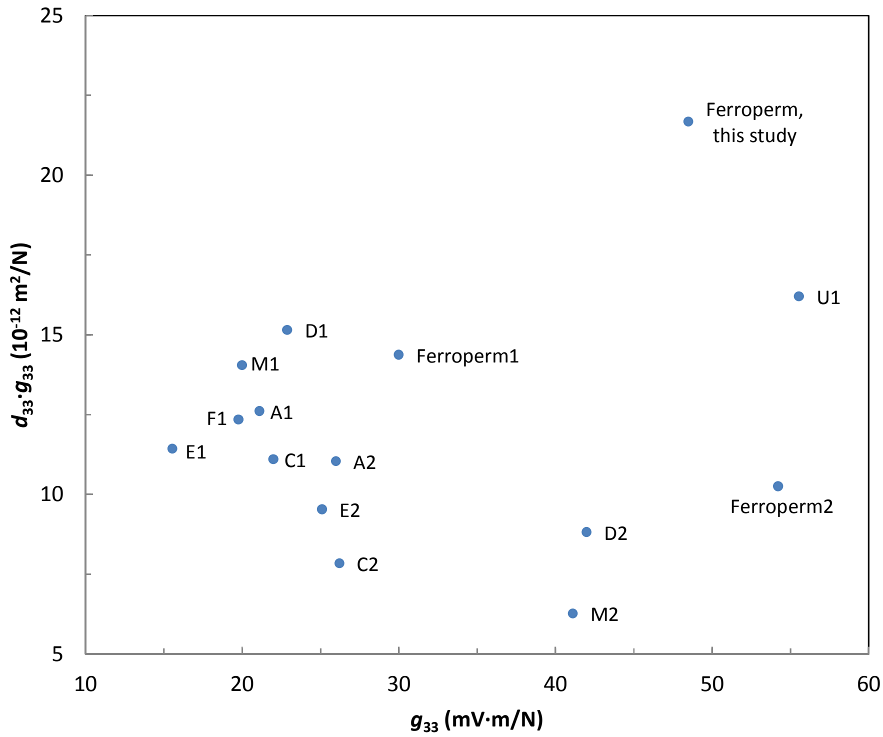

Figure 1. Low-frequency energy harvesting figure-of-merit $d_{33}{\cdot}g_{33}$ for a number of commercial piezoceramic materials, plotted versus g_{33} (after [1]).

The present work deals with vibrational energy harvesting where the input energy is kinetic (acceleration or strain) and the focus will be on piezoelectric ceramic materials. A number of different ceramic technologies will be compared – thick films integrated with MEMS, tape casting and conventional bulk ceramics – and relevant generator designs will be considered in each case. When it comes to choosing a suitable piezoceramic material, a number of functional properties need to be taken into account and these are conventionally combined into a single figure-of-merit, depending on the operation mode (low frequency or resonant [2]). This concept will be used here to compare a number of piezoceramic materials, including various types of doped PZT and some lead-free compositions, as the example in Fig. 1 shows.

The performance of various energy harvesting generators manufactured by this group will be summarised in terms of open-circuit voltage and output power as a function of excitation frequency and amplitude, and a comparison with results from the literature will be given.

References

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