Frequently asked questions

Question:

What is the difference between Hard and Soft PZT?

What material should I choose for a certain application?

Answer:

Hard materials have a low dielectric loss, and a high mechanical Qm value. This makes them suitable for applications, where you want to transmit as much power as possible. The sensitivity of such materials is however not very high.

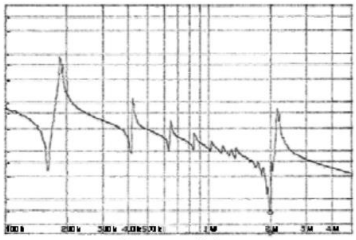
Hard PZT materials in Ferroperm's programme are Pz24, Pz26 and Pz28.
Datasheets for each material can be downloaded from our resources page

Soft materials have higher sensitivity, higher displacement, and a lower mechanical Q value. This makes them suitable for sensor applications. The loss is however higher, and they are therefore not able to transmit very high power without having problems with overheating and depolarisation.

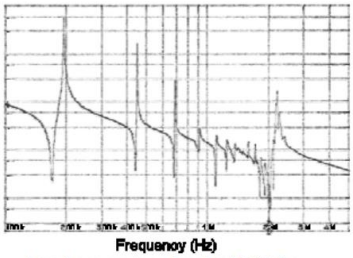
Soft PZT Materials in Ferroperm's programme are Pz21, Pz23, Pz27 and Pz29.
Datasheet for each material can be downloaded from our resources page.

The difference between the two types can clearly be seen in a plot, where the impedance is measured as a function of frequency. In the figures below, two piezoceramic circular discs with the same dimensions, but made from Pz27 (soft) and Pz26 (hard) are shown. In the soft material very clear resonances can be observed, with a quick deterioration of overtones due to the low Qm value.In the hard type the high Qm value however give long "ringing", and even high order overtones have a significant size.

In many parts made from hard type piezoceramics the higher order overtones can often interact with a higher fundamental mode, and cause a splitting resonance.



Impedance spectrum for a soft PZT disc.
The part exhibits clear and undisturbed resonances with overtones that quickly "rings out".



Impedance spectrum for a hard PZT disc.
Note that overtones from the fundamental planar resonance interfere with the thickness resonance.

Based on the above general remarks it can thus be seen, that a good starting point in your material selection process is to identify the power-level you need to handle in your application.

In low-power applications you often need a soft material with high sensitivity. Pz27 is a good starting point for most applications, but Pz21 and Pz29 can often improve results once it has been established, that there will not be any problems with elevated temperature or high mechanical stress levels.

For high power transmitters you often need a hard material with low losses in order to avoid risks of overheating or depolarisation. The most common material for high-power transducers is Pz26, so this will most often be a good starting point in new designs. Transducers operated at very high pre-loads sometimes make it necessary to use Pz24 or Pz28 instead of Pz26.

If a combined transducer is needed, i.e. the piezoceramic part acts both as a transmitter and a receiver, the most normal choice is Pz27, but both softer and harder types can be suitable depending on other requirements.

If there are any doubts on what material to select, please do not hesitate to contact us, and we will do whatever we can to assist you further.