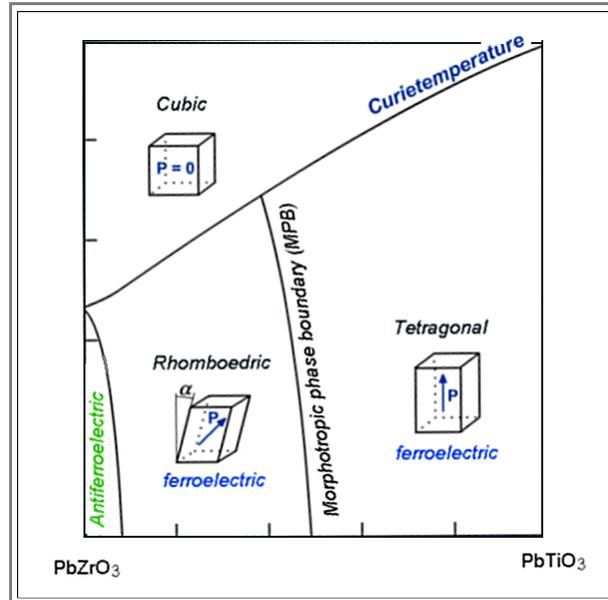


## PZT or Lead-Zirconate-Titanate

### Advanced

- ▶ PZT is short for Lead (= **P**) zirconate (= **Zr**) titanate (= **Ti**) or  $\text{Pb}[\text{Zr}_x\text{Ti}_{1-x}]\text{O}_3$ . It is mixture of  $\text{PbTiO}_3$  and  $\text{ZrTiO}_3$
- Both constituents are Perovskites as described in the [backbone](#). For temperatures below the Curie temperature we have spontaneous polarization as indicated in the phase diagram (adopted from Wikipedia).



- ▶ Both lattice pictures in the phase diagram are hugely exaggerated. Drawn to scale, the eye would not see a difference to a perfect cube. The relation of the axis' in the tetragonal case is about **1,06**, and the angle  $\alpha$  in the rhomboedric structure, for example, is around **0.3°**.
- This rather small distortions are large enough, however, to produce major permanent polarization effects.
- ▶ The interesting part is the "**morphological phase boundary**" (**MPB**) where the structure changes - but not the constituents. Several properties, most interesting for us the "dielectric constant", show pronounced maxima on the **MPB**; "theoretically" they could diverge to infinity.
- More down to earth, a mixture of tetragonal and rhomboedric crystals have all together **14** possible directions for spontaneous polarization. In other words, no matter what the external field direction might be, there is always an "easy" direction available in the **PZT** that is not too steeply inclined to the field direction.
- ▶ As always, optimizing the mixture and adding some other "dopants" or better alloying elements, can produce a large range of properties.