

What is a ferroelectric - a materials designer perspective

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Ferroelectrics are usually defined as polar materials that display polarisation hysteresis. This is a functional definition. A structural definition exists too, based solely on symmetry arguments. The structural definition, useful e.g. for design of new materials, says that a ferroelectric is a material that underwent a phase transition from a parent higher-symmetry phase into a polar phase, such that the permitted polar directions in this polar phase are linked to each other by symmetry operations of the parent phase.

Ferroelectrics will be discussed in this tutorial from a structural point of view. The structural definition will help also in clarifying the relationship between ferroelectrics and antiferroelectrics, conducive for the design of new antiferroelectrics and tuning of existing ones. Relaxor ferroelectrics will be discussed too, in the structural context. The contemporary material $(\text{Na}_{1/2}\text{Bi}_{1/2})\text{TiO}_3$ will then be used to illustrate the subjects discussed and the existing knowledge, and to point out missing understanding.