Hidden lattice distortions in crystalline functional materials
- Optical recording and negative thermal expansion materials -

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Lattice distortions play an important role for some modern functional materials. One of the examples is to decrease thermal conductivity. Another is to decrease entropy difference between solid and liquid (amorphous) states. Optical recording is based on a phase transition between crystal and amorphous phases, which are metal-like and insulating, respectively. The optical recording material is melted every time for the phase transition. In order to increase the memory capacity, the thermal conductivity should be low enough to reduce the recording unit size. At the same time, the reflectivity contrast between the phases should also be high for the memory reading. In addition, the reading and writing speeds are also an important factor for the application. The rapid phase transition is realized due to the small entropy change between them. These contradicting conditions challenge material scientists to design good functional materials. The difficult conditions can be overcome by having at least two types of crystallographic sites. One disordered site limits the thermal conductivity, whereas the other ordered site carries electrons or holes with high mobility. This problem is not limited in optical recording materials but also in thermoelectric materials. The atomic pair distribution function (PDF) analysis is one of the best methods to investigate the form and size of crystalline parts in those materials [1-5].

References

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