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1 **Local structures of perovskite dielectrics and ferroelectrics via pair distribution function**
2 **analyses**

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10 **Abstract**

11 The pair distribution function (PDF) method provides a useful way of characterizing the diverse
12 and richly complex local structures in perovskite dielectric and ferroelectric materials. This
13 review provides a basic introduction to the PDF method and the underpinning total scattering
14 experiments. Results are reviewed from *ex situ* PDF that describe composition-dependent local
15 structures and “box-car” fitting approaches to characterize longer range structures and length-
16 scale effects. *In situ* PDF studies are reviewed that are sensitive to the local structural response of
17 perovskites to temperature, electric field, and pressure. The dynamic pair-density function is also
18 briefly introduced as well as examples of local structure analysis using combined inputs, e.g.,
19 extended X-ray absorption fine structure spectroscopy, Raman spectroscopy, and first-principle
20 calculations. These advances in advanced and integrated analysis, dynamics, and *in situ* methods
21 will enable the PDF method to continue enlightening dielectrics and ferroelectrics research in the
22 coming decades.

23 **Keywords:** Perovskite; ferroelectric ceramic; local structure; pair distribution function; total
24 scattering measurement.

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