Low Temperature X-ray Diffraction Study on Phase Transitions

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The low temperature x-ray diffraction (LTXD) is essensial technique to study the crystal structure change phase transition. But when the structural phase transition occurs at very low temperatures such as below 1 K, the structure change becomes very small which makes it so hard to observe the crystal structure change by LTXD. In this case we found that the full width at half maximum of the x-ray spectrum (FWHM) increases due to the crystal structure change. This increase of FWHM gives some information about the crystal structure phase transition. In our present report we will mainly discuss the integrated intensity (I.I.) of the x-ray spectrum. The temperature dependence of I.I. can be expressed by the Debye-Waller factor. As a precursor effect of the crystal phase transition, the softening of the lattice occurs. Due to the softening of the lattice, the I.I. drastically decreases down to the crystal phase transition temperature, We observed this effect in many materials. In our present report, we will show some of them, antiferro-quadrupolar orderng compounds $Ce_xLa_{1-x}(x = 1, 0.75, 0.70)$, iron pnictide superconductor $SmFe_{0.925}Co_{0.075}AsO$, and other compounds $PrCu_4Ag$ and $Nd_2Ti_2O_7$.