

Recent Nuclear Resonant Inelastic Scattering Studies of Filled Skutterudites and Related Compounds

Satoshi Tsutsui

Japan Synchrotron Radiation Research Institute, SPring-8, Sayo, Hyogo 679-5198, Japan

Filled skutterudites are a member of clathrates with a cage structure. The presence of a localized mode has been discussed with many experiments [1-6]. However, most of experiments are indirect observations based on an Einstein model. Nuclear resonant inelastic scattering (NRIS) is only an experimental technique to measure an element specific phonon density of states directly [7]. In this sense, we can conclude that NRIS is a powerful tool to discuss the presence of localized modes.

We have carried out the NRIS of filled skutterudites and related materials for recent years. We have measured the NRIS spectra of Sm-filled skutterudites. The frequency of the Einstein-like modes shows the cage size and/or electronic state dependences [8]. The ^{149}Sm and ^{57}Fe NRIS results demonstrate the strong hybridization between the Einstein-like modes due to Sm atoms and acoustic contribution due to Fe atoms in $\text{SmFe}_4\text{P}_{12}$ [9]. We have observed a dip structure in ^{57}Fe NRIS at the same energy where the excitation due to the Sm atomic vibration is observed by ^{149}Sm NRIS. This is different from the reported results in $\text{EuFe}_4\text{Sb}_{12}$ using ^{151}Eu and ^{57}Fe NRIS [5]. Recently, we succeeded in the ^{121}Sb NRIS [10]. We have obtained the ^{121}Sb NRIS spectrum as well as ^{149}Sm and ^{57}Fe ones in $\text{SmFe}_4\text{Sb}_{12}$. Unlike the results of $\text{SmFe}_4\text{P}_{12}$, the NRIS results agree with the previous results in $\text{EuFe}_4\text{Sb}_{12}$ [5, 8].

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