SPring-8

Nuclear Resonant Scattering Beamline, BL09XU

This beamline is a standard X-ray beamline with a 32 mm-period linear undulator and a liquid-nitrogen cooled monochromator. Intense X-rays up to 80 keV can be produced and more than 30 kinds of nuclear levels exist in this energy range mainly. The following researches of nuclear resonant scattering are performed using the high-resolution optics and the time differential measurements in the several-bunch operation; Study of dynamics in materials using nuclear inelastic scattering; Time domain Mössbauer spectroscopy; Coherent X-ray optics using nuclear resonant scattering (NRS).The following researches are also performed using the multi high-precision goniometer system; Nuclear excitation by electron transition (NEET), Surface study; X-ray non-linear phenomena and; Residual strain analysis.

Direct observation of atomic motion in a nano-scale cage — Toward a novel model for the development of thermoelectric devices —

Atomic motion in a nano-scale cage is an important issue relating to the discovery of new thermoelectric materials. Previous works suggested that the atoms in such cages vibrate freely without affecting the motion of the cage atoms, and that such a vibration might scatter the acoustic modes that carry heat. This mechanism could then be responsible for reducing the thermal conductivity of the cage compounds, such as the skutterudites shown in Fig. 1, improving their thermoelectric behavior.

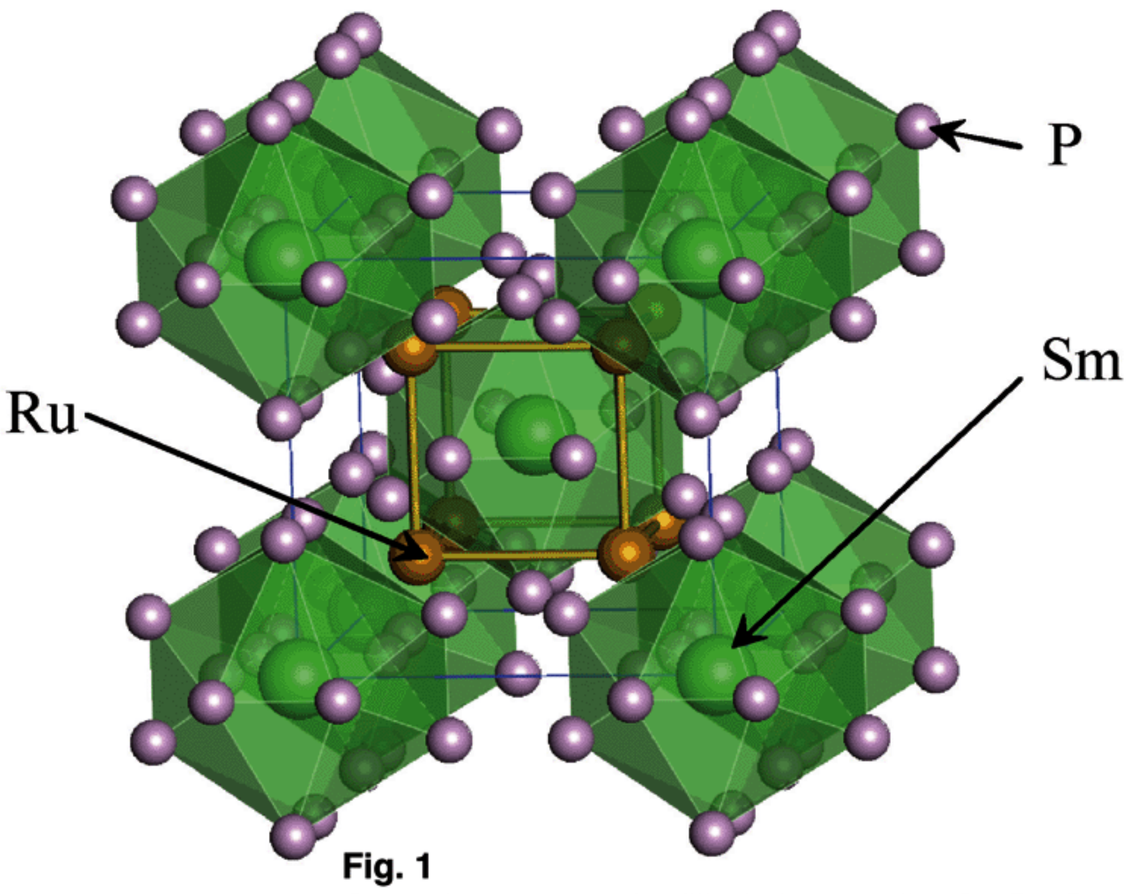

Fig. 1
Crystal structure of a filled skutterudite $SmRu_4P_{12}$.

Dr. S. Tsutsui (JASRI/SPring-8), Prof. H. Kobayashi (Univ. of Hyogo), Dr. A. Q. R. Baron (RIKEN/SPring-8) and their co-workers carried out nuclear resonant inelastic scattering at BL09XU and high resolution inelastic x-ray scattering at BL35XU to show that this is not the case: that the motion of the atom inside the cage in fact affects the acoustic modes in a filled skutterudite.[1] This gives some impetus to develop a new understanding of thermoelectric materials.

[1] Satoshi Tsutsui, Hisao Kobayashi, Daisuke Ishikawa, John P. Sutter, Alfred Q. R. Baron, Takumi Hasegawa, Norio Ogita, Masayuki Udagawa, Yoshitaka Yoda, Hideya Onodera, Daisuke Ishikawa, Chihiro Sekine, Ichimin Shirotani and Hideyuki Sato, Journal of Physical Society of Japan, **77**, 033601 (2008).