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Cross-talk between extremely short-life phonons detected on SIKA at ANSTO

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Although Dr. John White's research focused mainly on using Small Angle Neutron Scattering, we are honoured to dedicate this science revealed on Cold Neutron Triple Axis Spectrometer SIKA at ANSTO to Dr. John White for his support and guidance during the construction of SIKA and the establishment of Taiwan Neutron Scattering Society (TWNSS).
In the search for green energy, thermoelectric material has been demonstrated to be a promising material for the generation of electricity from waste heat recovery without pollution waste. The most essential factor for a material to possess effective thermoelectric character is the low thermal conductivity to maintain a temperature gradient over the material for long last thermal electrical transport. This presentation focus on using a neutron triple-axis spectrometer to answer the key questions linked to the functionalities of thermoelectric materials. One of the key factors for effective thermoelectric performance is a low lattice thermal conductivity that frequently links to the limitations on lattice vibrations.
Phonon dispersions measured using inelastic neutron scattering cover the entire Brillouin zone reveal very strong electron-phonon and phonon-phonon scattering leading to a huge softening of the phonon energies, extremely short phonon lifetimes in the order of 5 ps, extremely short phonon propagation lengths in the order of 5 Å, and negative group velocities at large wavevectors for the acoustic phonons in a 8%-Sb-and-6%-Bi codoped Ge0.86Sb0.08Bi0.06Te. It is the very short phonon lifetimes that giving rise to the low thermal conductivity observed at temperatures as high as 800 K. The very limited phonon propagation length together with the negative phonon group velocity at large wavevectors that restrict heat transport, which explains the origin of the poor thermal transport as a result of a very strong electron-phonon scattering in Ge0.86Sb0.08Bi0.06Te.

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