

TIME (DO NOT FILL IN)

IR and THz Spectroscopies of Solids at Extreme ConditionsShin-ichi Kimura*UVSOR Facility, Institute for Molecular Science,
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Recently, new quantum phases of solids appearing at extreme conditions such as high pressures, high magnetic fields and low temperatures are attracting attention, because new physical properties that have never been observed at ambient conditions and the advent of new functionalities are expected. Therefore it is important to study the electronic structure of new quantum phases at extreme conditions for the investigation of the origin of the new physical properties.

The electronic structure that is the origin of physical (thermodynamic) properties as well as functionalities is located in the energy region of about 100 meV below and above the Fermi level. The electronic structure is mainly detected by an optical spectroscopy in the IR and THz regions and recently by a high-resolution angle-resolved photoemission spectroscopy (HR-ARPES). HR-ARPES is a powerful experimental method because band dispersions as well as Fermi surfaces can be determined. However, HR-ARPES cannot be performed at high pressures and at high magnetic fields. On the other hand, even though the optical spectroscopy, i.e. reflectivity and transmission measurements, is difficult to connect to the electronic structure because obtained spectra are proportional to the joint density of states between the occupied and unoccupied states, it can be performed at the extreme conditions. Therefore, the optical spectroscopy is useful to study the electronic structure at extreme conditions.

Extreme conditions, especially high pressures, can be realized in a tiny region (several 0.1 mm in diameter typically) because high pressure cell, for instance a diamond anvil cell, must be used. Then microscopic measurements are necessary. Synchrotron radiation in the IR and THz regions is a powerful light source to get informations from samples in high pressure cells because of its high brilliance nature.

We have developed beamlines and end stations for IR and THz spectroscopies at extreme conditions at SPring-8 [1] and UVSOR-II [2]. Up to now, we performed the IR spectroscopy of CeSb at multi-extreme conditions of a high pressure (4 GPa), high magnetic fields (≤ 14 T) and low temperatures (~ 4 K) [3], the THz spectroscopy at extremely-low temperature (~ 0.4 K) [4] and the THz spectroscopy of SmS at high pressures (≤ 6 GPa) at room temperature [5]. Recently we started to measure the pressure-dependent THz spectra at low temperature. In this talk, the development of the apparatuses for IR and THz spectroscopies at extreme conditions and our recent topics will be discussed.

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