Research Center for Structural Thermodynamics

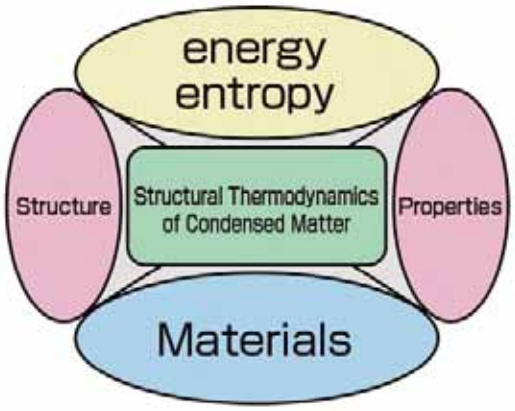
Introduction

Materials necessary for our life are assembled systems of atoms and molecules which have various microscopic degrees of freedom. Quantum mechanics which describe detailed energetic and structural aspects in atomic and molecular level were developed from early 20th century. Various experiments to derive direct information in microscopic levels are being performed nowadays on the basis of these microscopic knowledge. On the other hand, changes of physical properties in condensed phases are dominated by cooperative phenomena of multiple atoms and molecules interacting each other. To understand such phenomena and to inquire into profound nature of functionality of materials which occurs in various scales, thermodynamic discussion is inevitable. Furthermore, thermodynamic approaches are required for complicated systems including biological ones, since fundamental discussion based on molecular thermodynamics are no doubt important in them. The research center for structural thermodynamics has a mission to explore scientific researches through accurate and reliable evaluation and discussion of thermodynamic nature of materials by precise thermodynamic measurements. Original calorimetry systems with high accuracy and precision are also developed for this purpose. The target materials cover wide range of condensed phases including liquids, solids, liquid/plastic crystals, nano-composites, biological substances etc. To connect microscopic degrees of freedom dominated by quantum mechanics to various macroscopic phenomena and functionalities is important role for this center.

Research Projects

The followings are major research themes of the center.

1. Thermodynamic investigation of molecule-based magnets.
2. Thermodynamic investigation on dynamics and hydration of biomolecules and macromolecules.
3. Thermodynamic approach to biological phenomena.
4. Thermochemical approach to chemical bonds.
5. Structure and thermodynamics of two-dimensional solids formed at various interfaces.
6. Thermodynamic approach to hydration of electrolytes and non-electrolytes in their solutions.



The History and Future Scope of the Center

The “Chemical Thermodynamic Laboratory” was founded in 1979 by Prof. Syûzô Seki to study various physicochemical problems including phase transitions, critical phenomena and molecular energetics. Since 1989, this center was succeeded by the “Microcalorimetry Research Center” to expand the project to wider area. The “Research Center for Molecular Thermodynamics” was founded in 1999 to explore thermodynamics of functional molecules. In 2009, the forth institute “Research Center for Structural Thermodynamics” was founded to continue for another ten years by focusing on fundamental understanding material structures, order/disorder phenomena in molecular levels in condensed states.

The aim of the center is to dedicate to fundamental science based on accurate measurements of enthalpy and entropy. Unique thermodynamic activity should be performed with an international collaboration.