CALORIMETRY UNDER EXTREME CONDITIONS OF TEMPERATURE, PRESSURE AND COMPOSITION

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Although calorimetric methods for studying heat capacities and heats of reaction have existed for many years, extending them to accurate measurements under extreme conditions remains a challenge. In this talk, extreme conditions refer to temperatures above 2000 K, pressures above 5 GPa and highly reactive chemical species. Developments at ASU in high pressure measurements using a large multianvil apparatus in our FORCE facility enable synthesis of relatively large samples and their quenching to ambient conditions, as well as both in situ and ex situ structural and thermochemical properties. Here I summarize these developments, illustrating them with examples of newly measured thermochemical parameters for phase transitions in oxides, nitrides, carbides, and chalcogenides. The controllable complex relations among long range structure, polymorphism, short and mid range order, and crystallinity enable the synthesis, recovery, and technological application of a wide range of new materials.