Synthesis, Structure and Properties of Materials at High Pressure

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Background:
Discovery of fundamentally new materials has always been a fascinating and important aspect of materials chemistry. High pressure synthesis – wielding pressures up to 1,000,000 atm. – is an efficient way to discover and stabilize new materials. Pressure furthermore provides a unique and clean method to gain understanding of atomic interactions and structure-property relations. The first Danish high pressure laboratory for both synthesis and characterization of materials at extreme conditions has recently been established at AU Chemistry/iNANO. These unique new facilities are used to study a wide range of material classes and phenomena under pressure, e.g. magnetic materials, topological insulators, phase transformations, superconductors, superhard materials and more. We collect data in our home-lab at AU as well as abroad, at large international facilities. These include synchrotron X-ray sources where the very best data is acquired (prepare for sleepless nights). A wide range of projects are offered with different emphases on lab work vs. data analysis, depending on your interests. A few examples are listed below. Please email me or drop by my office for more information.

Techniques:
Synthesis by solid state, hydrothermal and high pressure methods (e.g. large volume presses). Crystal growth methods
Synchrotron X-ray and Neutron powder diffraction (diamond anvil cells)
Physical Property Measurements (PPMS), at ambient and high pressure

Project suggestions:
High pressure synthesis and diffraction studies of hard metal nitrides
Synthesis of alkali osmate superconductors, high pressure transformation and physical properties
Development of property measurements at high P and low T

Examples of previous Bachelor projects:
Simone M. Søndergaard-Pedersen, High pressure synthesis of bismuth chalcogenides, Bachelor thesis, Aarhus University, 2014
Jakob Bach Sigvardt, Pressure induced phase transformations in the β-pyrochlore CsW2O6, Bachelor thesis, Aarhus University, 2014

Relevant literature: