

Synchrotron Radiation: An Extraordinary Tool to Probe the Solid State at Extreme Conditions

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Third generation synchrotron radiation sources have contributed largely to the remarkable growth of research in physics of condensed matter under extreme conditions. In this presentation, I will review recent developments in techniques for the generation of very high pressures and temperatures on materials combined with the use of high brilliance synchrotron light to probe the solid state by X-ray diffraction. Following a brief introduction on the physics of materials subjected to extreme conditions, I will then concentrate on recent studies of the unusual crystalline structures of high-density phases of molecular solids and metal hydrides carried out by single crystal and powder X-ray diffraction techniques using synchrotron radiation. I will show and discuss the transformations, induced by high pressure, of the molecular arrangement in correlation with the insulator-to-metal transition observed in solid oxygen. I will also present recent results, obtained at the CLS Hard X-ray Micro Analysis Beamline, on the change of crystalline state of dense calcium and barium hydrides, as materials for potential hydrogen storage systems. I will then conclude with a discussion of prospects for a structured research program of science at extreme conditions at the Canadian Light Source.