Department of Physics
National Central University

Colloquium

Novel functional materials exploration and characterisation utilizing high pressure techniques

台灣大學凝態中心

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Novel functional materials design and discovery for magnetic, electronic, spintronic and energy technology applications stimulate much of modern chemistry, physics and materials sciences. Such functional materials are in particular interests due to their correlated electron systems ground states, and the sensitivity to changes in chemical composition and physical condition. These strongly-correlated materials tend to have dense and strongly-bonded structures, high pressure synthesis techniques therefore become one of the most important approaches in the novel materials exploration, and the high pressure condition may induce more interesting physical properties.

High pressure syntheis techniques were introdued to prepare bismuth nickelate perovskite, and high pressure charazterisation techniques were utilised to reveal intriguing pressure-induced melt of charge dispropornation and inter-site charge transfer. And in order to investigate the coupling between crystal structure and physical properties, a novel analogue $HgMn_7O_{12}$ and a series of A-site ordered double perovskite AMn_7O_{12} materials were prepared utilizing high-pressure high-temperature synthesis techniques. Detailed structural analysis with synchrotron X-ray and neutron diffraction techniques were performed and rich spin, charge and orbital couplings were observed in these materials. Distinct behaviors of the analogue AMn_7O_{12} suggest that the phenomena of orbital and magnetic ordering and their intrinsic coupling are very sensitive to the A oxidation state and consequently B-cation valence. A few recent discoveries of such exotic systems will be also discussed.

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