Charge dynamics in $Y_{1-x}Ca_xVO_3$ investigated by resonant inelastic x-ray scattering

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It is well known that Mott gap nature contributes closely to exotic characters realizing in strongly correlated $3d$ transition metal oxides, such as metal-insulator transition, charge and orbital ordering, superconductivity, and colossal magnetoresistance. In this study, we have investigated charge dynamics of valence electrons and doped holes into the system by a momentum-resolved resonant inelastic x-ray scattering experiment.

In YVO3, one representative example of an orbital ordering 3d-metal perovskite, coupling between large orbital fluctuation and a lattice distortion causes two kinds of characteristic order of dyz and dzx orbital. Below 200 K, three dimensionally staggered orbital ordering is realized, namely the G-type orbital order (G-OO). The G-OO orbital configuration transits from staggered to align along c-axis at 74 K (C type OO). On the other hand, YVO3 is also an archetypal Mott-Hubbard type insulator. Then the Mott gap excitation has been represented by electron hopping between next metal sites.

The RIXS experiment at the V K absorption edge was performed at BL11XU installed at SPring-8. Temperature dependence of the RIXS spectrum across the transition temperatures has suggest that the Mott-Hubbard excitations with excitation energy from 1.5 eV to 3.5 eV are affected by orbital ordering state sensitively. From the measurement of a momentum dependence of the excitations, we determine the dispersion relation of the Mott-Hubbard excitations. The RIXS measurement allows first-hand insight into a structure of the narrowly-defined Mott Hubbard gap. We will also discuss hole-doping dependence of the Mott gap excitations and in-gap state on $Y_{1-x}Ca_xVO_3$.