Electronic structure change due to migration of oxygen vacancies in Ca-doped $BiFeO_3$

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Doped correlated oxide systems would have shown exotic electronic condution phenomena such as metal-insulator transition, superconductor and magnetoresistance. Bismuth ferrite ($BiFeO_3$), one of popular multiferroic materials, has a large ferroelectric polarization and an antiferromagnetic order. Due to a stable oxidation number of Fe ions, the divalent ion (Ca^{2+}) doping on $BiFeO_3$ cannot produce hole carriers due to formation of oxygen vacancies. In order to explore the electronic conduction of doped $BiFeO_3$ compounds, we fabricated a coplanar electrode structure and applied an electric field across the electrodes at a high temperature. As a result, we can make relatively oxygen-vacancy-deficient areas in between, thereby producing a p-type doped region. In this talk, we will present our recent observations of electronic transport properties. In addition, we introduce its electronic structure which was characterized by x-ray absorption spectroscopy (XAS) and photoelectron emission microscopy (PEEM) in a beamline (BL25SU) of synchrotron SPring-8. Remarkably we have observed doping-driven occurrence of a new peak 2 eV below the t2g peak in oxygen K-edge spectra. Interesting interplay between doping ratio. Furthermore, spatially-resolved x-ray circular dichroism (XMCD) enables us to study the local spin and orbital angular momenta varying depending on the hole carrier doping.