Electronic structure of half-metallic ferromagnet CrO_2 studied by VUV-ARPES

T. Setoguchi[a], N. Kataoka[a], S. Kumar[b], S. Ideta[b], K. Shimada[b], T. Wakita[c], Y. Muraoka[a, c] and T. Yokoya[a, c]

[a]*Graduate School of Natural Science and Technology, Okayama University, 3-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530, Japan*
[b]*Hiroshima Synchrotron Radiation Center, Hiroshima University, 2-313 Kagamiyama, Higashi-Hiroshima 739-0046, Japan*
[c]*Research Institute for Interdisciplinary Science, Okayama University, 3-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530, Japan*

Keywords: Half-metallic ferromagnet, ARPES

Half-metallic ferromagnets have only one electronic spin state at the Fermi level. Due to this characteristic property, they are expected to be used as the completely spin-polarized sources in the field of spintronics. Among that kind of materials, one of the most promising materials is chromium dioxide(CrO_2). About 100% of spin polarization was observed at 1.8K in CrO_2 by means of Point contact Andreev reflection [1], which means that this is ideal for the completely spin-polarized sources. However, the spin polarization decreases as the temperature increases and it does not obey the temperature dependence of macroscopic magnetization. The reason for this marked decrease was recently attributed to non-quasi particles, which is many body effects originated from the peculiar half metallic electronic structure, from high resolution spin-dependent photoemission spectroscopy [2]. On the other hand, CrO_2 is expected to be a Weyl ferromagnet, which is Weyl topological material with time-reversal symmetry breaking[3]. In Weyl materials, bulk Weyl fermions and surface Fermi arcs can be observed. To experimentally verify these interesting electronic structure angle-resolved photoemission spectroscopy (ARPES) measurement is a powerful tool. Though previous soft-x ray(SX) ARPES studies have reported overall band dispersions [4], the energy resolution of SXARPES is not enough to investigate these electronic structure.

In this study, we have performed vacuum ultraviolet VUV-ARPES of CrO_2 at BL1, HiSOR. Generally, it is said that photoemission spectroscopy by using light with vacuum ultraviolet (VUV) range is relatively surface-sensitive technique. Therefore, cleanness of sample surface is important. However, surface of CrO_2 easily tends to change Cr_2O_3 and this makes it difficult to observe intrinsic electronic state of CrO_2. To solve this problem, we have synthesized high quality films using closed system chemical vapor deposition in evacuated quartz tube [5], prepared those films in a glove box filled with Ar and measured the films without exposing them to atmosphere.

By using this method, we could successfully observe a clear band dispersion and Fermi surface of CrO_2. We will discuss the electronic structure of CrO_2 using obtained high-resolution ARPES data.

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