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Angle Resolved Photoemission Spectroscopy Study of Sr4Ru3O10 single crystals and Intrinsic Bi2Te3 Topological Insulator Thin Films

Monday, 16 November 2015 12:00 (20 minutes)

In the first half of this talk will focus on three-layered strontium ruthenate single crystals. Strontium ruthenates of the Ruddlesden-Popper (R-P) series Sr_{n+1}Ru_nO_{3n+1} have been subject to intensive research since they exhibit distinct collective physical phenomena that are due to the change of the number n of the RuO₆ octahedra layers in the unit cell. The phenomena observed range from unconventional spin-triplet superconductivity in Sr₂RuO₄ (n=1) [1], quantum critical metamagnetism in Sr₃Ru₂O₇ (n=2) [2]; and anisotropic ferromagnetism and proposed orbital-dependent metamagnetism inSr₄Ru₃O₁₀ (n=3) [3].

Little is known in literature about the microscopic origin of the metamagnetic transition in Sr₄Ru₃O<sub>10</s
Previous experimental and theoretical work on Sr₃Ru₂O₇ (n=2) have suggested a band structure-based model of metamagnetism to explain its phase diagram [4]. According to this model, it is expected to find van Hove singularities in the density of states near the Fermi level. The same scenario is expected to be valid for Sr₄Ru₃O₁₀ [5]. Experimental information on the near Fermi level electronic structure of Sr₄Ru₃O₁₀ is thus needed to investigate the origin of magnetic fluctuations in Sr₄Ru₃O₁₀.
In this presentation, I will show the first electronic structure measurements on Sr₄Ru₃O₁₀ performed at synchrotron using angle resolved photoemission spectroscopy (ARPES) [6]. In particular, I will discuss the near Fermi level band dispersion and the Fermi surface topology of Sr₄Ru₃O₁₀ single crystals. Next, I will discuss band dispersions of Sr₄Ru₃O₁₀, which reveal a complex density of states that is susceptible of giving rise to van Hove singularities near the Fermi level; a situation expected to be the origin of the magnetic fluctuations in Sr₄Ru₃O₁₀.

In the second half of this talk, I will discuss ARPES data on intrinsic Bi₂Te₃ topological insulator thin films. Topological insulators (TIs) are materials with an insulating bulk interior and spin-momentum-locked metallic surface states as a result of a band inversion from large spin-orbit interaction [7]. Bismuth telluride (Bi₂Te₃) is one of the 3D topological insulators (TIs) that have received a considerable amount of attention as potential candidates for room temperature spintronics and quantum computational devices[7]. However, despite significant progress in TI material preparation, growing high-quality TI materials for transport experiments is still a major challenge. Often, bulk carrier conduction complicates direct observation of surface effects in transport measurements.

Here, I will give a brief overview of our current research on thin films of topological insulator [8]. Our combined in-situ spectroscopy, especially angle resolved photoemission spectroscopy study of molecular beam epitaxy grown Bi₂Te₃ reveal topological surface states without a contribution from the bulk bands at the Fermi energy[8]. Investigation of the effect of pure oxygen exposure at atmospheric pressure; and the effect of ex-situ contamination in air show that the surface electronic band structure of our Bi₂Te₃ films are not affected by in-vacuo storage and exposure to oxygen; whereas major changes are observed when exposed to ambient conditions [8]. In future, we might perform these investigations at synchrotron in order to cover a wider spectral range with an intense and highly polarized continuous spectrum with the purpose of making detailed study of the valence photoemission spectra of our topological insulator thin film samples.

References
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Summary

Use of soft x-rays (ARPES) on two different systems: Sr4Ru3O10 single crystals and Bi2Te3 topological insulator thin films.

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