

The 21 Century COE Project
Exploring New Science by Bridging Particle-Matter Hierarchy

Short-term Foreign Researchers

Research Report

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Your Stay Period in Japan: From Feb. 28, 2004 to March 12, 2004

Title of Research in Japan: Electronic structure of strongly correlated systems.

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Please write a research report of one or more pages and submit it with this cover to your host researcher till the end of this March.

During the period of this stay, we planned to initiate collaborative researches on a number of topics related to the overall theme to investigate electronic structure of strongly correlated systems. To this end, we have identified several systems that we wish to study in great detail using extremely high-resolution photoemission spectroscopy over a wide temperature range. Some of the systems identified so far are M_xWO_3 ($M = Na$ and K), $Er_5Ir_4Si_{10}$ (and related systems), Sr_2FeMoO_6 and MVO_3 ($M = Ca$ and Sr). These systems were identified through extensive discussions during the first few days of my stay in Sendai; we also discussed the details of the experiments in each case during this initial period.

We have already collected several of these samples. Some of the samples were synthesized in Bangalore, while the others are from different sources around the world. We decided to investigate the M_xWO_3 system first due to the ready availability of a large number of compositions within this series. The experiment was started with Na_{0.025}WO₃ sample. Single crystals of this sample was mounted on sample holder and oriented appropriately. Several of these samples were mounted in to the spectrometer for a detailed angle resolved photoelectron spectroscopic investigation. The samples were cleaved in-situ under the ultra-high vacuum condition. Preliminary results showed a small intensity feature at about 2.5 eV binding energy with interesting temperature dependence; it had a sharp feature with a sizable intensity below about 160 K, while it lost its intensity and sharpness quickly above 200 K. Therefore, it was decided that we should record detailed angle resolved photoemission data at several temperatures spanning the interesting temperature regime. We recorded angle resolved spectra at about 130, 230 and 300 K. These results clearly showed that besides the large intensity features at higher binding energies arising primarily from O 2p derived states, there are low intensity states close to the Fermi energy. At each temperature, the entire range of spectral range of interest was therefore, divided in to two parts, a region around the O 2p states to study the dispersion of these states and a region close to the Fermi energy to obtain the pseudo Fermi surface of this sample. We observe many interesting variations in these results both as a function of temperature and energy. Further investigations are now going on.