5 ERATO Non-Equilibrium Dynamics Project

5-1 Outline

The Non-Equilibrium Dynamics Project under the Exploratory Research for Advanced Technology (ERATO) program of the Japan Science and Technology Agency (JST) was launched at the northwest site of the PF-AR in October 2003. The five-year project is lead by Professor Shin-ya Koshihara (Department of Chemistry and Materials Science, Tokyo Institute of Technology), and is mainly devoted to (1) construction of beamline AR-NW14A at the PF-AR, (2) 100 ps time-resolved X-ray studies of non-equilibrium states, (3) the preparation of organic or inorganic materials that show strongly correlated phenomena, (4) the investigation of photo-induced phase transitions using time-resolved optical measurements, and (5) a feasibility study for femtosecond X-ray science using newly-developed femtosecond X-ray sources. In order to explore a wide range of time-domain science, researchers from various fields such as ultrafast laser science, solid state physics, crystallography, and synchrotron radiation are gathered together in the project. Currently the project consists of more than 10 members, including researchers, students and administrative staff (Figure 1). Collaborations with foreign and domestic research groups are in progress.

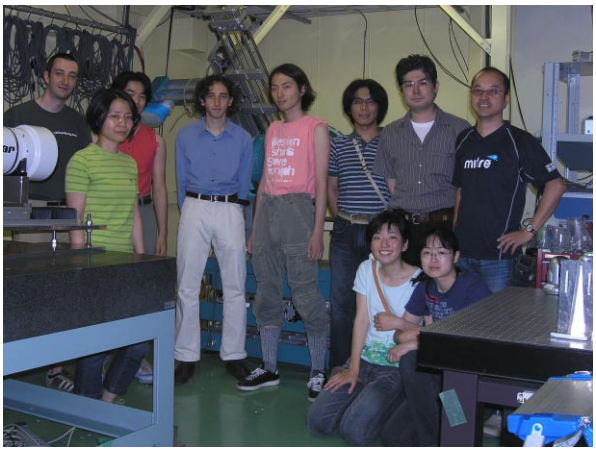

Figure 1
Members of the project.

5-2 Research Subjects

The main research subject of the project is photo-induced phenomena in condensed matter physics. In particular, photo-induced phase transitions (PIPT) are extensively studied at beamline AR-NW14A using an optical pump, X-ray probe technique. For example, strongly correlated materials such as organic charge transfer complexes and transition metal oxides are studied using femtosecond laser pulse pumping. The subsequent phenomena are followed using 100 pico-second time-resolved X-ray diffraction. In spite of many technical obstacles encountered during the pump-probe experiments, the project members have combined forces in order to find solutions, and have been gradually reaping the fruits of their efforts.

In addition to the PIPT studies, we are developing a variety of applications using pulsed X-rays, including time-resolved (TR-) XAFS, TR-protein crystallography and TR-solution scattering. Most of these experimental setups have proved to be feasible at AR-NW14A, and preliminary experiments are underway.

5-3 Beamline Development

The construction of AR-NW14A for time-resolved X-ray diffraction, scattering and absorption experiments was completed in summer 2005, and the beamline is now fully operational. The technical details of the beamline have published recently [1], and the current status of AR-NW14A construction is also described in the Experimental Facilities Chapter of this volume (see page 69).

References

[1] S. Nozawa, S. Adachi, J. Takahashi, R. Tazaki, L. Guerin, M. Daimon, A. Tomita, T. Sato, M. Chollet, E. Collet, H. Cailleau, S. Yamamoto, K. Tsuchiya, T. Shioya, H. Sasaki, T. Mori, K. Ichiyanagi, H. Sawa, H. Kawata and S. Koshihara, *J. Synchrotron Rad.*,**14** (2007) 313.