5.10. Mr Yoshiaki Kiyanagi (Japan)

Introduction

The pulsed neutron imaging using the time-of-flight method can give structural information on materials by using the characteristic features of the wavelength dependent neutron transmission. The crystal structure (lattice spacing), crystallite size, and preferred orientation in metal materials are investigated by analyzing the Bragg edge shapes and the elements by the resonance absorption peaks. Such information is important for characterizing the steels and other metal products, and only our group has the data analysis code for deducing such information. It is useful to apply the pulsed neutron imaging to the cultural heritages since the method helps to understand smithing and smelting processes of the specimens. The transmission method gives position dependent information and the diffraction gives complemental and more detailed data for the crystal structures and the textures. Therefore, the combined use of these methods is very useful for studying rigorously the crystal structure of cultural heritage samples. We have already collaborated with the Italian group for this direction, since the group has been performing the diffraction study. Therefore, we promote the research collaboratively for comprehensive and rigorous understanding of the crystallographic characteristics of the cultural heritages and archeological specimens.

The main object of this study is to obtain comprehensive crystallographic information of the cultural heritages and archaeological samples, and to understand the historical or regional difference of the smithing and the smelting. To obtain such outcomes we are planning to perform mainly the pulsed neutron imaging using NOBORU at J-PARC, HUNS at Hokkaido University and INES at ISIS. We are the only group that can obtain the crystallographic images by using the pulsed neutron experiments coupled with the data analysis code we developed. In parallel we improve the Bragg edge analysis code and develop the data analysis code for the resonance absorption.

Experimental facilities

J-PARC spallation neutron source: high power spallation neutron source at MLF (Material and Life science experimental Facility) at J-PARC in Japan. We can perform the neutron transmission experiments using the instrument called 'NOBORU', a test experimental beam line. The present power is about 200kW. In this instrumental area we can put relatively large equipments for the transmission experiments and get high statistics and high wavelength resolution data (about 0.3% at 15m). The maximum beam size now is 10x10 cm^2, and L/D of 140, 190, 600 and 1875 are obtainable. The Maximum intensity is about $5x10^7$n/sec/cm^2 at 1MW.

Hokkaido University neutron source (HUNS): There is an electron linac based neutron source at Hokkaido University. This is a pulsed neutron source applicable to various fields of neutron experiments. The source neutron intensity is $1.6x10^{12}$n/sec. L/D is about 50 for cold neutron experiments and about 100 for resonance measurement. Time resolution is about 4% for cold neutron region. We also have various neutron detectors such as pixel-type detector, RPMT detector and GEM detector. This facility can be operated by users, so the on-demand use is possible and easy. We perform various kinds of transmission experiments which are sprouting and do not need high wavelength resolution.

Cooperation

For this study the collaborated work with the Italian group (Dr. M. Zoppi group) is essential since they have valuable experiences on the neutron diffraction study on the cultural heritages. The comparison between the transmission data depending on the position and the diffraction data on the large area is very important to understand the crystallographic feature of the samples.

Main objective	Sub objectives	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Soft ware development	Bragg edge	X	X	X	X	X	X	X	X				
	Resonance			X	X	X	X	X	X	X			
Detector development	GEM	X	X	X	X								
	Neutron color I.I.			X	X	X	X	X	X				
Database (measure of a number of certified reference samples)	Run Diffraction/transmission experiments on INES		X	X									
	Data Analysis		X	X	X								
	Selection of a few representative samples			X	X								
	Run transmission experiment in Sapporo/J-parc			X	X								
	Critical comparison of results (joint meeting)				X								
Measurements of selected iron&steel samples (Europe, Indian, Japan)	INES experiments					X		X		X			
	Hokkaido University / J-parc experiments						X		X		X		
	Data analysis						X	X	X	X	X		
	Critical comparison (meeting)										X	X	
Report	**Meeting**												**X**