1.23 NEUTRON SCATTERING EQUIPMENTS IN JAERI CURRENT STATUS

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Abstract

24 neutron scattering measurement equipments are installed in the JRR-3M research reactor. JAERI has 12 neutron scattering equipments. These equipments are HRPD for high-resolution structural analysis, TAS-1 and TAS-2 for elastic and inelastic scattering and for magnetic scattering measurements by the polarized neutron, LTAS for elastic with inelastic scattering measurement at a low energy region, and for neutron device development, PNO for topography and for very small angle scattering measurement to a small Q range, NRG for neutron radiography, RESA for internal strain measurements, SANS for the molecule and semi-macroscopic magnetic structural analysis, BIX-2 and BIX-3 for the biological structural analysis research, PGA for the research of prompt gummer-ray analysis. The university groups have 12 neutron scattering equipments.
Since these equipments were installed at the period when JRR-3M was completed, about 10 years have passed. In order to match old control systems with the progress of recent computer technologies, and peripheral equipments, a lot of equipments are being renewed.
In the neutron guide hall of JRR-3M, exchange was performed to the super mirror guide tube of 2Q from Ni mirror guide tube for the purpose of neutron flux increase. The intensity of 2Å increased by about 2times.

1. Introduction

The main research reactor for the neutron scattering in Japan is JRR-3M, which is located in Tokai, Ibaraki, Japan.

24 neutron scattering measurement equipments are installed in the JRR-3M research reactor, which are belong to both JAERI and ISSP (Institute for Solid State Physics, Tokyo University)
JAERI has 12 neutron scattering equipments.

1) HRPD (High Resolution Powder Diffractometer) for high-resolution structural analysis,
2) TAS-1 and TAS-2 (Triple Axis Neutron Spectrometer) for elastic and inelastic scattering and for magnetic scattering measurements using the polarized neutron,
3) LTAS (Low Energy Triple Axis Spectrometer) for elastic and inelastic scattering measurement at a low energy region,
4) PNO (Precision Neutron Optics Instrument) for topography and very small angle scattering measurement to a small Q range,
5) NRG (Neutron Radiography) for neutron radiography,
6) RESA (Residual Stress Analyzer) for internal strain measurements,
7) SANS (Small Angle Neutron Scattering) for the molecule and semi-macroscopic magnetic structural analysis,
8) BIX-2 and BIX-3 for the biological structural analysis research,
9) PGA (Prompt Gummer Ray Instrument) for the research of prompt gummer-ray analysis.

The university groups have 12 neutron scattering equipments.

In the neutron guide hall of JRR-3M, exchange was performed from Ni mirror guide tube to the super mirror guide tube of 2Q for the purpose of neutron flux increase. The intensity of 2Å increased by about 2 times.

2. Improvement of instruments

2.1 Improvement of neutron scattering instruments

The almost all instruments for the neutron scattering measurement was installed in reactor hall and guide hall of JRR-3M in 1990. During past 10 years, the control and measuring system of each instrument became obsolescence due to the quick progress of electronic equipments. To improve the performance of system, several instruments were preformed updating.

The computer system, control system and software for the operation were renewals with the newest system in HRPD. In TAS-1, the computer system was updated and improvement of software was performed. In TAS-2, while the computer and control systems were updated, the materials for equipment and shielding of detector and monochrometor were replaced with non-magnetic materials, such as aluminum and non-magnetic stainless steel, for the use of apparatus producing very high magnetic field.

Renewal of computer and maintenance of software were performed. Improvement of attachment for RESA was performed in order to measure giant-size samples, such as engine machine. In SANS-J, during the renewal of computer and control systems, replacement of velocity selector system was preformed.

2.2 Improvement of guide tube

The natural nickel-coated neutron guide tubes, which introduce the neutrons from inside the reactor to guide hall, were modified to super mirror-coated ones. The purpose of which is to increase the neutron intensity and expand the energy width of outgoing neutrons in thermal guide tube T2. The expected spectra of outgoing neutrons are show in Fig. 1. The location of improvement in T2 is shown in Fig.2. Specification of super mirror guide tube is shown in Table 1. The measured intensity increase at 1.5 A neutrons was about three times.

3. Status of experiments in each instrument

As one cycle the JRR-3M is operated over four weeks, and in the following one week the reactor is stopped. JRR-3M is operated for seven-cycles in one year. The total number of experiments from April 2000 to March 2001 is 197, and the number of experiments for each equipment is shown in Table 2.

4. Conclusion

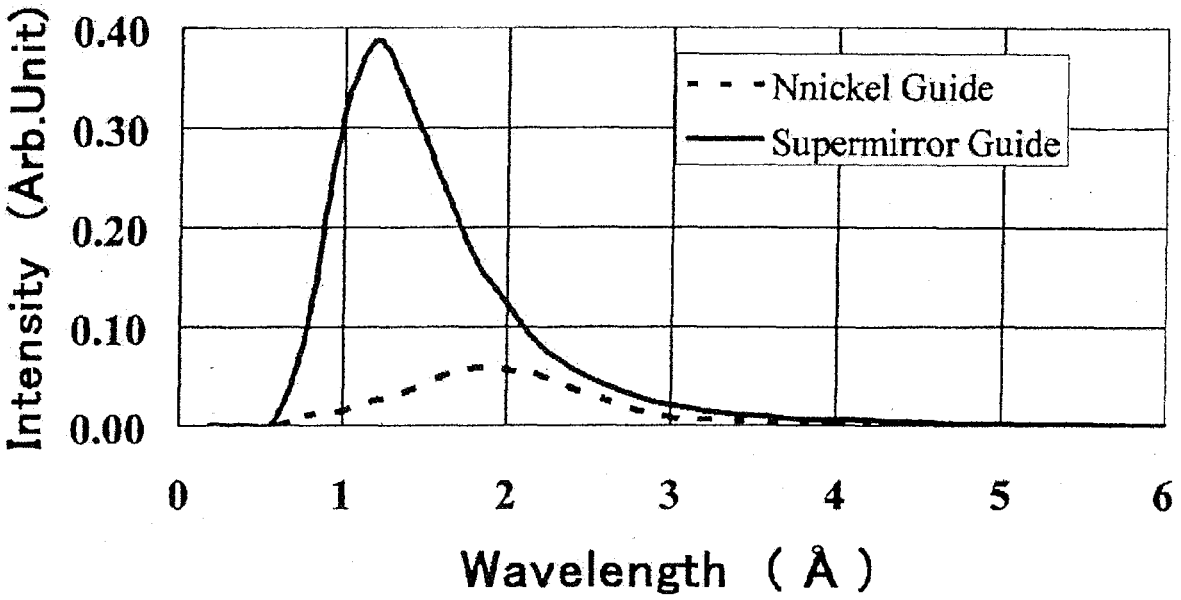
The neutron scattering instruments installed in JRR-3M will be used over the coming more than 10 years. The maintenance and improvement in each instrument will be performed extensively. Some of the instrument may be replaced with another new type of instrument. JAERI and University neutron scattering group members will make every effort for the utilization of neutron scattering instruments, beside the construction of new instrument installed in high intense pulse neutron source.

Fig.1 Distribution of simulated neutron spectra for nickel guide and supermirror guide.

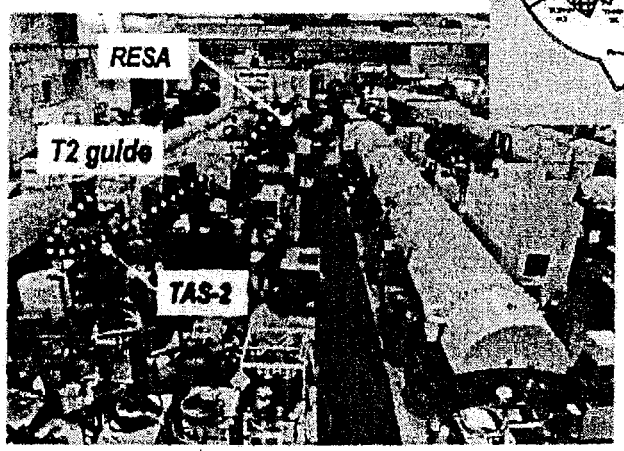
Fig.2 View and layout of the beam experimental facilities at the JRR-3M neutron guide hall.

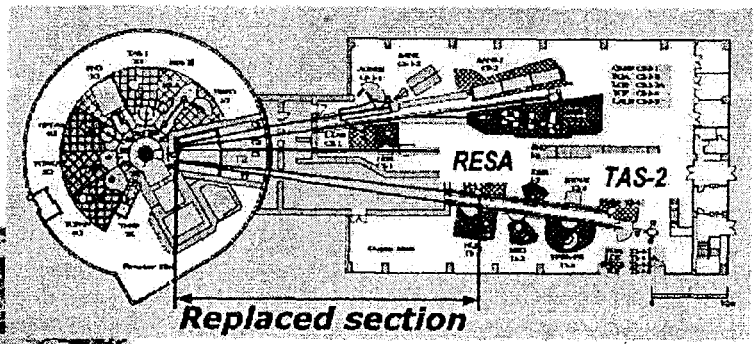
Table 1. Specification of supermirror guide tube at T2.

Distribution of simulated neutron spectra for nickel guide and supermirror guide



View and layout of the beam experimental facilities at the JRR-3M neutron guide hall





Specification of supermirror guide tube at T2

- **Total length :** 56.95 m
- **Curvature of guide tube :** 3340 m
- **Bent tube length :** 35.7 m
- **Width :** 2 cm
- **Height :** 20 cm
- **Total number of segments:** 67
- **Number of bent tube :** 42
- **Multilayer materials :** Ni/Ti
- **Critical angle of total reflection :** $2\theta_c^{Ni}$ (θ_c^{Ni}=1.73x10^{-3}radian/Å)
- **Reflectivity :** 80 % (at critical angle)
- **Thickness of Ni layer :** 77.4 -560 Å
- **Thickness of Ti layer :** 70.3 -156.5 Å
- **Number of layers :** 125 layers

Table-2 Number of Experiments for each NS equipment in JAERI

CYCLE	1	2	3	4	5	6	7
HRPD			5	7	5	6	9
TAS-1			6	4	5	6	6
TAS-2			3	5	5	6	7
LTAS	Reactor stopped with a trouble of cold neutron source.		4	3	3	2	3
PNO			2	2	1	2	5
SANS			5	6	4	8	6
RESA			5	7	7	7	7
BIX-2			5	1	2	3	2
BIX-3			2	2	2	2	2