Neutron Diffractometers at the Japanese Proton Accelerator Project

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The accelerator-based neutron source began in the end of 60's at Tohoku University which was succeeded by the spallation neutron sources of the four proton accelerators at the High Energy Accelerator Research Organization (Japan), Argonne National Laboratory and Los Alamos Laboratory (USA), and Rutherford Appleton Laboratory (UK). Since then, the next generation source has been pursued for 20 years, and 1MW spallation neutron sources will be appeared in about three years at the three parts of the world: Japan, UK and USA. The joint proton accelerator project (J-PARC), a collaborative project between KEK and JAEA, is one of them. The aim of the talk is to describe about J-PARC and the neutron diffractometers being installed at the materials and life science facility of J-PARC.

The materials and life science facility has 23 beam ports and will start delivering the first neutron beam from 2008 May. Considering the Day One scientific results of both KEK and JAEA and of outside users, 10 instruments were selected as project instruments. In addition, several instruments were proposed by outside organizations up to now. Here are possible neutron diffractometers available for the high pressure research at the beginning of J-PARC.

(1) Versatile S(Q) diffractometer (KEK): This is a super high intensity diffractometer with the highest resolution of delta d/d = 0.3%. This diffractometer is mainly for glass, liquid and amorphous structure analyses, but can cover crystal structure analyses. The pair distribution function will be obtained by the Fourier transiformation of S(Q) data.

Q range of the diffractometer will be 0.01A-1 to 100A-1.

(2) Materials Structure Diffractometer (Ibaraki Prefecture): This is a high resolution and high intensity diffractomer with the highest resolution of delta d/d = 0.12%. Ibaraki Prefecture is planning to provide the diffractometer to industrial research activity. Materials scientists are expected to use it like chemical analyzers in their materials development process. Then, the user system including education is quite important. Another important feature is that it covers wide Q range (0.01A-1 to 100A-1) to be utilized for varieties of structures: local structure, nano structure and crystal structure analyses.

(3)Super High Resolution Powder Diffractometer (KEK): SHRPD has the world highest resolution with delta d/d = 0.03% without sacrificing intensity. The combination of the high quality data from SHRPD and their high-precision analysis gives us information on tiny structural change which has been overlooked previously. The d-range is 0.5 to 4 A with delta d/d = 0.03 %, and 4 to 45 A with gradually changing resolution.

(4) Engineering Diffractometer (JAEA): This diffractometer is for stress mapping inside structure materials with the highest resolution of delta d/d = 0.2% (corresponding to 10-5 to 10-6 strain precision). The typical gauge volume will be 1 mm3. The geometric arrange of detectors will be similar to the typical high pressure dedicated instruments.