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The CMRR neutron scattering instruments and application

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The China Mianyang Research Reactor (CMRR) with the power of 20 MW is located in Mianyang city, Sichuan Province. The thermal and cold fluxes for neutron scattering experiments are 2.4×1014 n/cm2•s and 109 n/cm2•s, respectively. The reactor has run 120 days in 2016, and run more than 150 days in 2017. Now it has been included in the website: Neutronsources.org. Eight neuron scattering instruments have been operated normally from the middle of 2014. Four thermal neutron instruments were installed in the reactor hall: a high resolution neutron diffractometer (HRND), a residual stress neutron diffractometer (RSND), a thermal neutron radiography station (TNR) and a high pressure neutron diffractometer (HPDC). Four cold neutron instruments were installed in the guide hall: a small-angle neutron spectrometer (SANS), a time-of-flight and polarized neutron reflectometer (TPNR), a cold-neutron triple-axis spectrometer (CTAS) and a cold neutron radiography station (CNR). Intensive work has also been done for instrument improving during recent years. The texture measurement was realized on the RSND by utilizing the Kappa goniometer. The HPDC is has been upgraded with 6.7m focusing neutron guide to improve the flux, which has reached to 3 ×106n • cm-2 • s-1. The high pressure loading has realized maximum pressure 20GPa. The HRPD will be upgrade with high resolution and high intensity modes. SANS has changed the velocity selector with GE products and adjust the collimation system, thus the cold neutron flux at the sample position is 2×107 n•cm-2•s-1. The characteristics of the TPNR are the time-of-flight and polarization modes. Relative resolution of momentum transfer of the TPNR is $\Delta q/q=(0.5\sim5)\%$ for $q=(0.05\sim3.0)$ nm−1. The CTAS has an energy resolution of $\Delta E/E\leq2\%$ with a range of energy transformation of 0~10 meV.

Based on the neutron scattering instruments at CMRR, some interesting research experiments have also been done. RSND provides a unique tool for accessing the internal stress distribution and deform mechanism inside components. Neutron powder diffraction pattern gives the degrees of structure distortion and changes of bond lengths between Co/Fe and O in Co0.708Fe0.292WO4, CoWO4 and FeWO4, which has been published on Nano Energy. The finding of the localized NH4+ and totally disordered H+ in the battery of (NH4)3Zr(H2/3PO4)3 has been published on 2018. Some results of soft matter using SANS has been published on Macromolecules and Adv. Mater. etc. Some magnetic film study by TPNR has been published on Sci. Report. and Phys. Rev. Appl. etc.

The second phase for neutron instruments construction has been started from 2017. Three new instruments will be built within next 3-5 years, which are a polarized thermal neutron triple-axis spectrometer (TTAS), an ultra small-angle neutron spectrometer (USANS), and a neutron standard-test beam line (NSTB) for single crystal and texture measurement, respectively. More sample environment systems will be equipped for the present spectrometers, such as high/low temperature, high pressure, superconducting magnetic field, chemical loading (hydrogen/deuterium gas environment), and so on. Recently, we also get the funding for neutron spin echo spectrometer. The inelastic mode (LNRSE) and small angle mode (SESANS) are both under designed by split the C3 cold neutron guide using bend guide. The relative polarized 3He signal was firstly observed by FID NMR in May 4 2018. So it could be expected that more contributions for the neutron scattering will be made by our institute in China.

Topic

Neutron Facilities

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