The new IPEN-CNEN/SP Neutron Diffractometer equipped with a PSD

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The neutron powder diffractometer recently installed at the IPEN-CNEN/SP IEA-R1 research reactor is equipped with a position sensitive detector (PSD). In the PSD, eleven linear position sensitive ^{3}He detectors are stacked forming a planar array. The PSD spans 20° of a diffraction pattern with a quite good resolution. An extended powder diffraction pattern can be obtained by moving the detector in 20° segments in a 2θ angular interval ranging from 5 to 125°. A focusing Si monochromator and a rotating-oscillating collimator (ROC) were also installed in the new instrument. At a take-off angle of 84°, chosen for the monochromator, the following reflections/wavelengths (Å) can be easily attained: 533/1.111, 511/1.399, 331/1.667 and 311/2.191 Å. Switching between reflections 533, 511 and 311 only requires rotating the monochromator around a vertical [01-1] zone axis which is vertical to the monochromator. Switching to 331 requires flipping the monochromator bottom up with a full circle stage. The ROC, installed at the entrance to the detector shield, eliminates parasitic scattering from furnace or cryorefrigerator heat shields in the vicinity of the sample, while only reducing the scattered intensity by *ca*. 10%. It also makes the PSD less sensitive to ambient background. Owing to the utilization of the PSD associated with the focusing Si monochromator, the new diffractometer can measure a neutron powder pattern in a matter of ten to twenty hours with a good statistics. In this work, details of the construction of the new instrument, as well as descriptions of the procedures adopted to put it into operation, are presented. A first procedure employed was orientation of the Si monochromator in the neutron beam in order to get the wavelength $\lambda = 1.399$ Å A second procedure was the calibration of the PSD. According to the position where a neutron is detected in one linear detector belonging to the PSD array, a position encoder module (PEM), connected to the preamplifiers at both ends of the detector, adds one unit to the intensity accumulated in a channel whose number corresponds to the position of detection. All intensity points of the raw data, obtained in a particular linear detector, form a raw pattern that must be corrected for the Debye-Scherrer and planarity effects of the PSD. This is done in the second calibration where the raw patterns are corrected for such effects, then plotted against a 2θ angular scale and summed giving as result the neutron powder pattern for the substance under study. Several neutron powder patterns, obtained with different compounds, will be presented in order to give an idea of the quality of the new instrument. Use of the IPEN-CNEN/SP PSD neutron diffractometer is open to the scientific and technological communities from Brazil and other Latin-American countries.

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