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Modernization of neutron Fourier chopper for High-resolution Fourier diffractometer (HRFD)

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The High-resolution Fourier diffractometer (HRFD) is operated at the pulsed reactor IBR-2 of FLNP JINR allowing to carry out precision research of the crystal structure and microstructure of inorganic materials. The use of the fast Fourier chopper for intensity modulation of the primary neutron beam and the correlation method of diffraction data accumulation is a principal feature of the HRFD design. This allows one to obtain extremely high resolution ($\Delta d/d \approx 0.001$) at HRFD in a wide range of interplanar distances at a relatively short flight distance from the chopper to the sample position (L = 20 m). In 2016 the old Fourier-chopper (the operation period ~20 years) was replaced with a new one manufactured by the Mirrotron Ltd company (Hungary). The basic mechanical characteristics of the previous version of the Fourier chopper, particularly, the rotor diameter, the number of slits, the slit length, the slit width at the middle, the absorbing material Gd2O3 and the width of the layer Gd2O3, have been maintained in the new Fourier chopper for HRFD. The rotor is produced from the high-strength Al based alloy and allows a maximum rotation speed of 6000 rpm. As compared to the previous version, the rotor and the stator are installed in a hermetic casing, the mechanical design of the stator allows one to have exact configuration and fixation of the pick-up signal phase, a new type of incremental magnetic pickup sensor of the chopper disk rotation speed with an interpolation factor of 2 instead of 8 is applied, the rotor vacuum and vibration monitoring sensors are installed, a new control system for stator position is used. The new pick-up signal sensor and control system have allowed one to decrease the differential nonlinearity of the rotor instant speed to ~2.5%.
The chopper control and monitoring system based on the software logic controller Omron provides the predefined law of change in the Fourier-chopper rotation speed and monitors the readings of the vacuum, vibration and temperature control sensors.

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