Implementation of the Rococo 2 silicon drift detector at the cryogenic endstation of Beamline P06 at Petra III

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The new “Rococo 2” X-ray fluorescence detector was implemented into a cryogenic sample environment and operated at the P06 microprobe experiment at the Petra III beamline P06 at, DESY (Hamburg, Germany). To address the high processing speed necessary for the Rococo, an Xpress III pulse processor was installed together with the detector. The detector was operated in a backscattering geometry and is particularly suited to investigate extended planar samples. It provides a high energy resolution, a high count rate and a high signal to noise ratio of 15 000. A mean energy resolution of 128.7 ± 0.9 eV could be measured over all four readout channels of the detector using a 55Fe radioactive source. A maximum outgoing count rate of 4.7 · 10⁶ counts/s could be achieved and a corresponding dead time of 107 ms (11 %) could be estimated. Due to its design, the Rococo detector can be placed in close proximity to the sample, which results in a large solid acceptance angle of up to 1.1 Sr. The large solid acceptance angle enhances the detection sensitivity and allows an accurate determination of trace element distributions in thin samples of frozen hydrated biological specimens. First measurements using 2D scans with a continuous scanning pattern of frozen hydrated HeLa cells as a model system were performed and XRF maps were recorded. In comparison to the previously used Hitachi Vortex-EM450 detector an improvement of the peak to background ratio by a factor of 30 could be observed on spectra of similar cryogenically frozen cell samples. Additionally, we can report an increase of the potassium signal by a factor of 3.24 and of the silicon signal by a factor of 42.6. An overall narrower energy resolution of the elemental peaks could be observed for the Rococo detector with a factor of 2 improved FWHM value for the potassium peak.