Benefits of the MYTHEN detector for XRF analysis in laboratory spectrometers

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The first spectroscopic experiments with Hybrid Photon Counting (HPC) detectors were carried out more than a decade ago [1, 2]. Ever since, HPC detectors are continuously changing the way we understand and practice X-ray spectroscopy at synchrotron beamlines. Although equally promising, the use of the HPC detectors had a slower headway in laboratory spectrometers. This work reintroduces the HPC detector MYTHEN detector as an advanced tool for the WD-XRF analysis in laboratory spectrometers. Two non-commercial WD-XRF spectrometers [3, 4] are used to illustrate the benefits of the HPC technology: extremely high resolution, in situ and time resolved measurements and pushed limit of detection.

Compared to the ED-XRF, the main benefit of the WD-XRF method is the energy resolution. This, unfortunately, comes with a cost: sensitivity can be relatively low, data collection time high and the price of the system high. Some of these drawbacks can be overcome by using a large-area and high-resolution detector.

In the presented XRF spectrometers, MYTHEN's large detection area is exploited to simultaneously collect energy spectrum of 1 keV without having to move the detector. This not only reduces the time to collect the data, but also simplifies the design of the spectrometer and thus reduces the production costs. These benefits come without compromises on the data resolution. Among the commercially available HPC-detectors, the MYTHEN has a narrowest strip size, what directly translates in very high resolution. It was shown that the resolution of the MYTHEN-based WD-XRF spectrometer can be pushed down to 2 eV, whereas the detector contribution is only 0.25 eV. That is, the resolution is only limited by the crystal.

MYTHEN detectors have noise-free operation, high dynamic range and high quantum efficiency for wide range of X-ray energies. This not only enables time-resolved and *in situ* measurements, but also gives and opportunity to replace expensive powerful sources with a cheaper version. Very long exposure time is not limited by noise, so the system is suitable for detecting elements in low concentrations.

Easy integration of the MYTHEN detectors is guaranteed by the versatile software interface. The detectors are radiation hard, maintenance-free and robust, what makes them easy to use.

[1] Kleimenov, E. *et al*. (2009) Journal of Physics: Conference Series **190** (2009) 012035

[2] Sato, K. *et al*. (2017) *X-Ray Spectrom*. **46**, 330-335, https://doi.org/10.1002/xrs.2797

[3] Németh, Z. *et al*. (2016) *Rev.Sci. Instrum*. **87**, 103105, https://doi.org/10.1063/1.4964098