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DETECTORS FOR DEMANDING X-RAY DIFFRACTION EXPERIMENTS

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Detectors are the crucial devices determining the quality, reliability and throughput of x-ray diffraction and scattering investigations in the laboratory as well as at synchrotron beam lines. The most important requirements for XRD are single photon counting mode with the lowest possible detector noise to achieve large peak-to-background ratio, high dynamic range, and high maximum count rate capability. Two detector technologies fulfil these requirements: gas-filled proportional counters and Silicon based solid state detectors, due to some of their distinctive features, have been successfully used for XRD applications (1-2). Both technologies still offer potential enhancement concerning the above mentioned properties as well as the energy and the spatial resolution. Numerous research activities, which are presently focussed on improving the overall performance of these detectors, will lead to the present characterization methods and to the creation of new applications.
The different technologies for both the 0-dimensional and the 1-dim XRD detectors are discussed in the view of specific application capabilities such as: energy range and resolution, count rate limits, background and dynamic range, size and spatial resolution. The use of x-ray diffraction methods is becoming increasingly attractive in the fields of Nano-science and material research, as well as in the nano-related industries owing to the recent advances in the x-ray detection technology. The next generation of these detectors will push the forefront of the research in materials science and will significantly improve both the throughput and the reliability of the industrial X-ray diffraction applications.

1) Kocsis et. al., Nuclear Instruments and Methods in Physics Research A 563 (2006) 172–176

2) Tarkowski et. al., Nuclear Instruments and Methods in Physics Research A 551 (2005) 178-182