BACKGROUND REDUCTION IN PROPORTIONAL COUNTER

Heikki Sipilä
Metorex International

In principle x-ray fluorescence is a good method also for trace element analysis. However, in practice there are serious limitations which make the otherwise good method useless. High excitation power, syncrotron source, polarization, wavelength dispersive method etc. are too expensive to be used in simple applications.

There are numerous industrial problems where a simple x-ray fluorescence probe could be an ideal solution. In many cases energy resolution is not a major problem, but the main obstacle is limited peak to background ratio.

When a discrete or filtered x-ray source is used for excitation the inherent background is very small. The main component in the background is bremstrahlung which is caused by photo- and Compton electrons from the absorbed excitation x-rays. What we perceive as a background spectrum of a solid state or proportional detector is a low energy tail under the peak caused by incomplete charge collection. In the case of a proportional counter this caused by the so called wall effect. The traces of energetic photoelectrons terminate on the walls of the counter before the ionizing electron has lost its energy into detector gas. It may be possible that the photoelectron from the wall or the window may enter to the detector gas and leave only partial absorption in the gas.

Different methods to remove this limitation are reviewed. A practical solution of this problem is presented. A proportional counter is designed so that near the wall, thin anticoincidence shield surrounding the whole detector cylinder is formed. Using a vetosignal from this anticoincidence shield, the signal from the central anode wire will be rejected. Peak to background ratio will be improved more than a decade and this method is fast, so that there is no need to use a low count rate. This method improves significantly eg. low sulphur content measurements from fuel. This application has practical importance because the new limit for sulphur in fuel will be 10 ppm.

Compared to a conventional detector, the appearance of the low background detector differs only in the second feedthrough for veto signal.