A.5.5. Correlation between Secondary Electron Emission Yields and Pulse Height Distributions from Multi-channel Plate (MCP) Particle Detector—*Hiro Tawara, D. Fry, and Martin Stöckli*

Multi-channel plate detectors are most widely used for slow particle detection. Yet, the detailed correlation between their pulse height distributions (PHD) and the secondary electron emission yields has not been pursued so far.

In the present work, we have tried to understand such correlation between two important parameters in the MCP, namely the secondary electron emission yield and pulse height distribution.

The secondary electron emission yields (γ) from SiO_2 surfaces under 1- 150 keV proton impact have been determined under a vacuum in the 10^{-11} Torr region through a conventional method by measuring the sum of the ion current onto a solid target and the secondary electron current emitted from the target, with the secondary electron current collected on a cylindrical electrode surrounding the target (the details have been described in another report here).

The observed results for the (relative) secondary electron emission yields, γ, are shown in Fig. 1 (with open circles) as a function of the proton impact energy. The γ-yields increase relatively slowly as the proton impact energy increases and reach a maximum ($\gamma = \sim 5.5$) at around 70 keV and tend to decrease very slowly at higher energies. This behavior is expected from the fact that (1) the secondary electron emission yields are strongly correlated with the ion energy losses, dE/dX, which are known to become maximum around 70-80 keV for protons [1] and (2), as the impact energy increases, higher energy electrons are produced in the forward directions and cannot escape the bulk surface. On the other hand, the pulse height distributions from the MCP (whose main constituent is SiO_2 with a minor surface treatment) have also been observed. In Fig. 1 are shown the peak (maximum intensity) position channels of the pulse height distributions (with solid squares) as a function of the proton impact energy. It is easily noted that the peak positions in the PHD move toward higher channels much quicker than those of the secondary electron emission yields and reach a plateau already at around 10 keV and, then, do not change very much up to 150 keV, the maximum energy in the present work. This early appearance of the plateau in the pulse height distributions can be attributed to the saturation of the MCP gain due to the relatively high resistivities through the capillaries of the MCP.

It should be noted that the primary protons are incident at nearly grazing angles onto the MCP and, thus, the absolute γ are different from those at normal incidence. But the qualitative discussion above should not be changed.

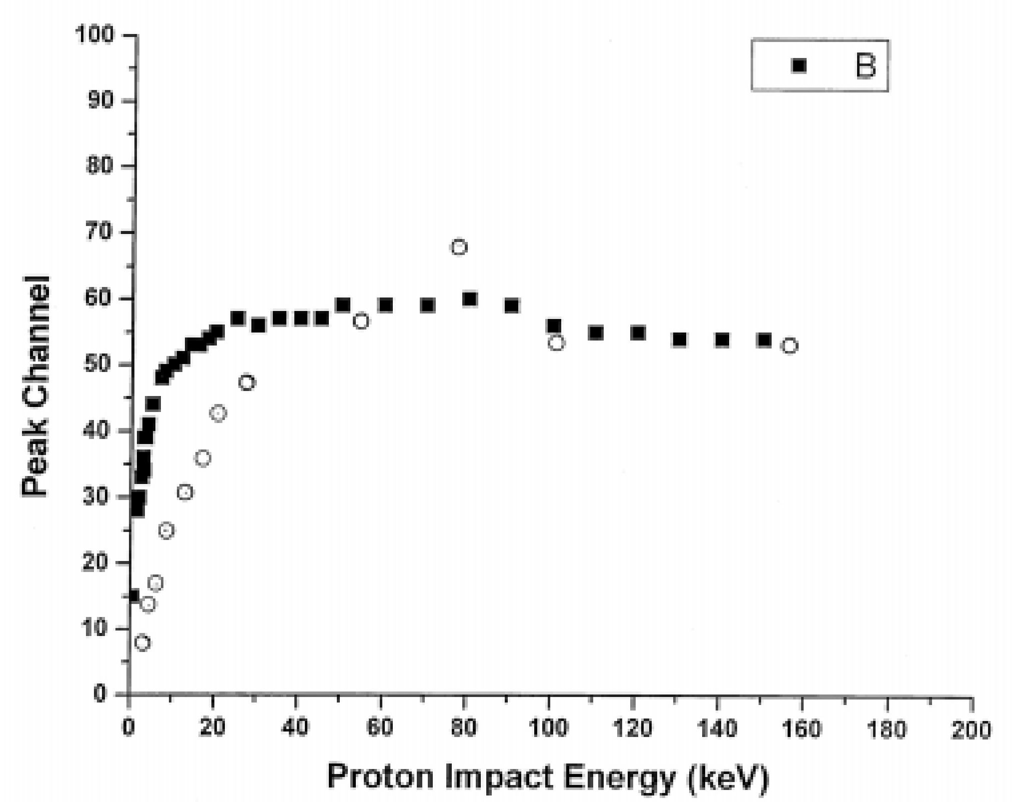

Figure 1. Peak positions in pulse height distribution from MCP under H^+ ion impact.

Reference

1. J.F. Ziegler *et al.*, *The Stopping and Ranges of Ions in Solids*, Vol. 1 (Pergamon, 1985).