Improving System Linearity in the HP/Agilent 5973 MSD

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Introduction

The HP/Agilent 5973 MSD has proven to be an extremely sensitive analyser. However, due to this increase in mass spectrometer sensitivity, many users have experienced severe limitations in system linearity. In applications where high concentration samples are routinely analysed, the original electron multiplier supplied with the MSD has been shown to have a limited range of linearity. Recent developments in discrete-dynode electron multiplier technology have been employed to produce a detector which significantly enhances 5973 system linearity. This paper presents design details of a new ETP Electron Multiplier detector (SGE P/N 14617) as well as “head to head” performance comparisons with the original equipment.

Detector Optical Design

The Model 14617 integrates innovations in both ion optics and dynode materials to enhance linear system response. The resulting design incorporates a focussed conversion dynode and several different dynode materials. Figure 1 shows the ion optical design.

Materials Design

In addition to ion optical design, efficient dynode materials are required to optimise performance. Traditional channel electron multipliers use a single material (usually SiO_2) throughout the detector. In actual operation, different areas of the detector are exposed to widely varied amounts of electron flux with the result that the output end degrades much more rapidly than the input. Figure 2 displays typical electron exposure levels for dynodes at different locations along the multiplier. Materials were selected which exhibit desired characteristics depending upon location in the dynode chain (i.e. materials near the input are selected for high gain, while those near the output end, where high fluxes are present, are selected for high stability and long lifetime.

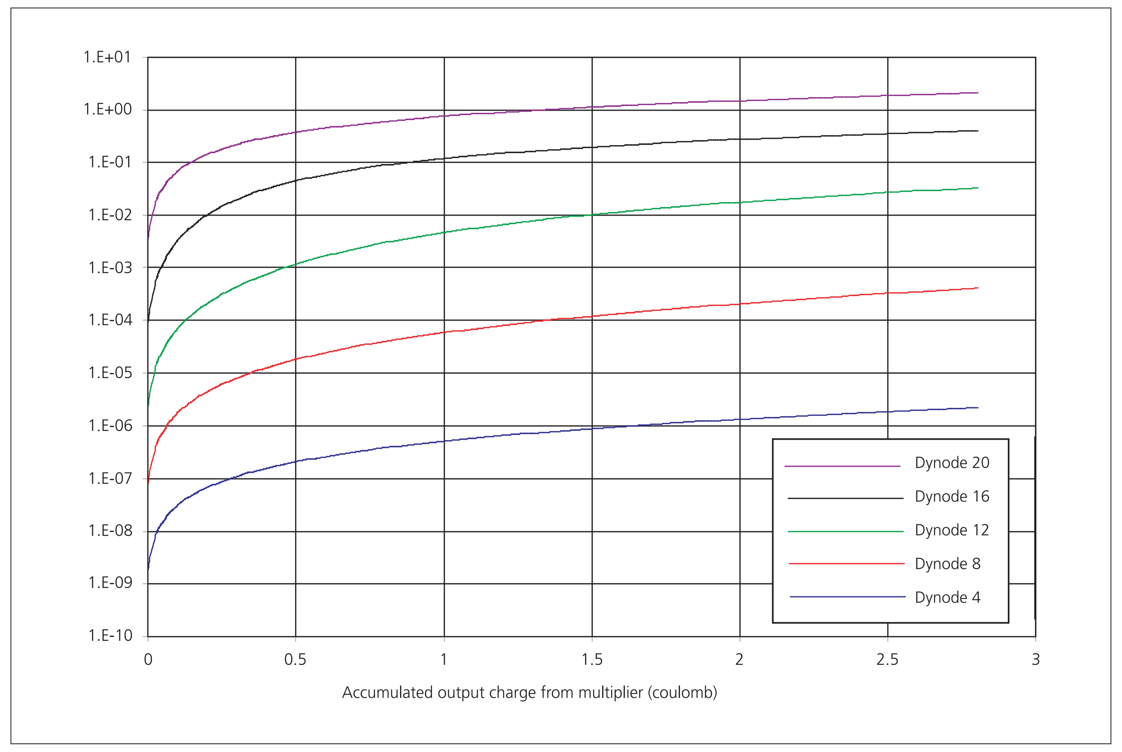


Figure 2. Typical electron exposure levels for dynodes at different locations along the multiplier.

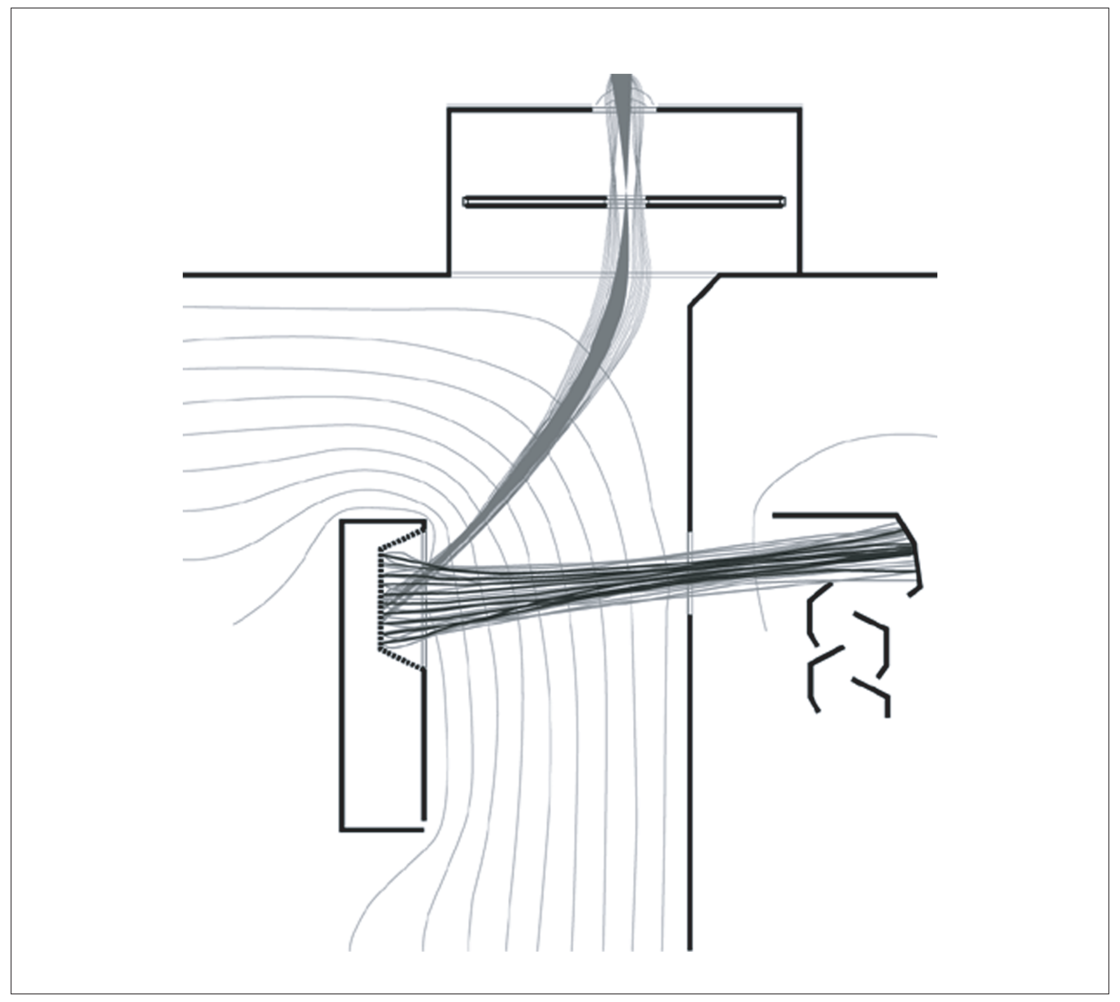


Figure 1. Ion optical design of the ETP 14617 electron multiplier detector.

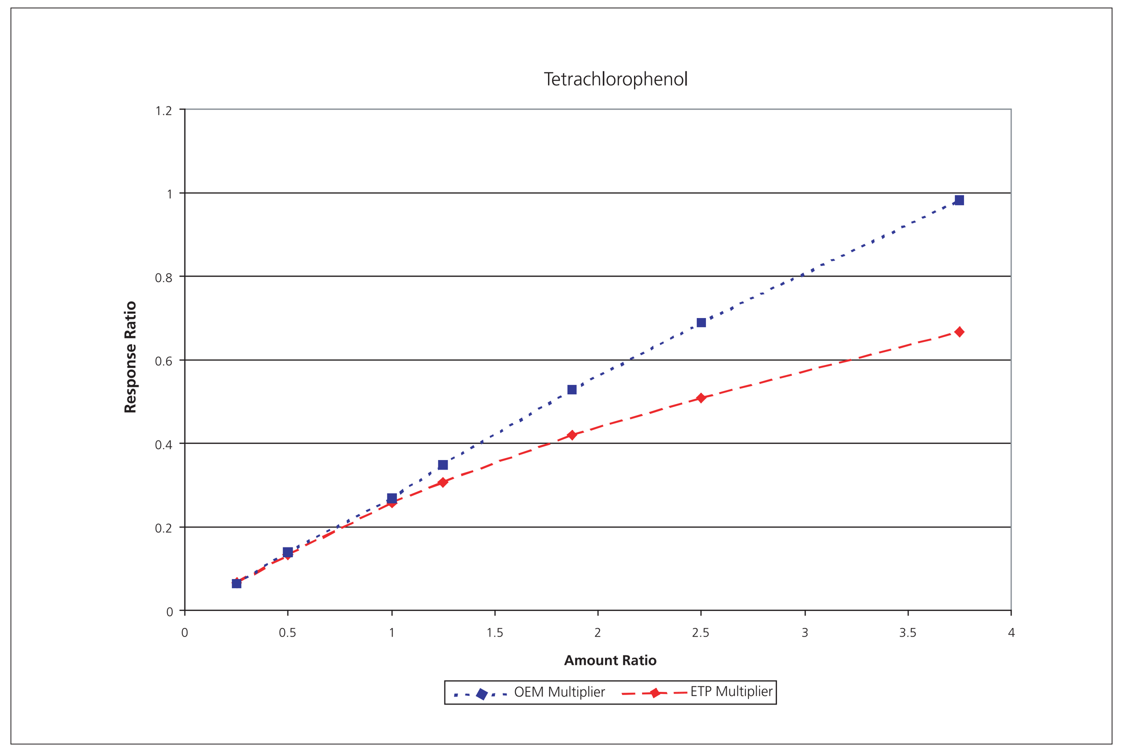
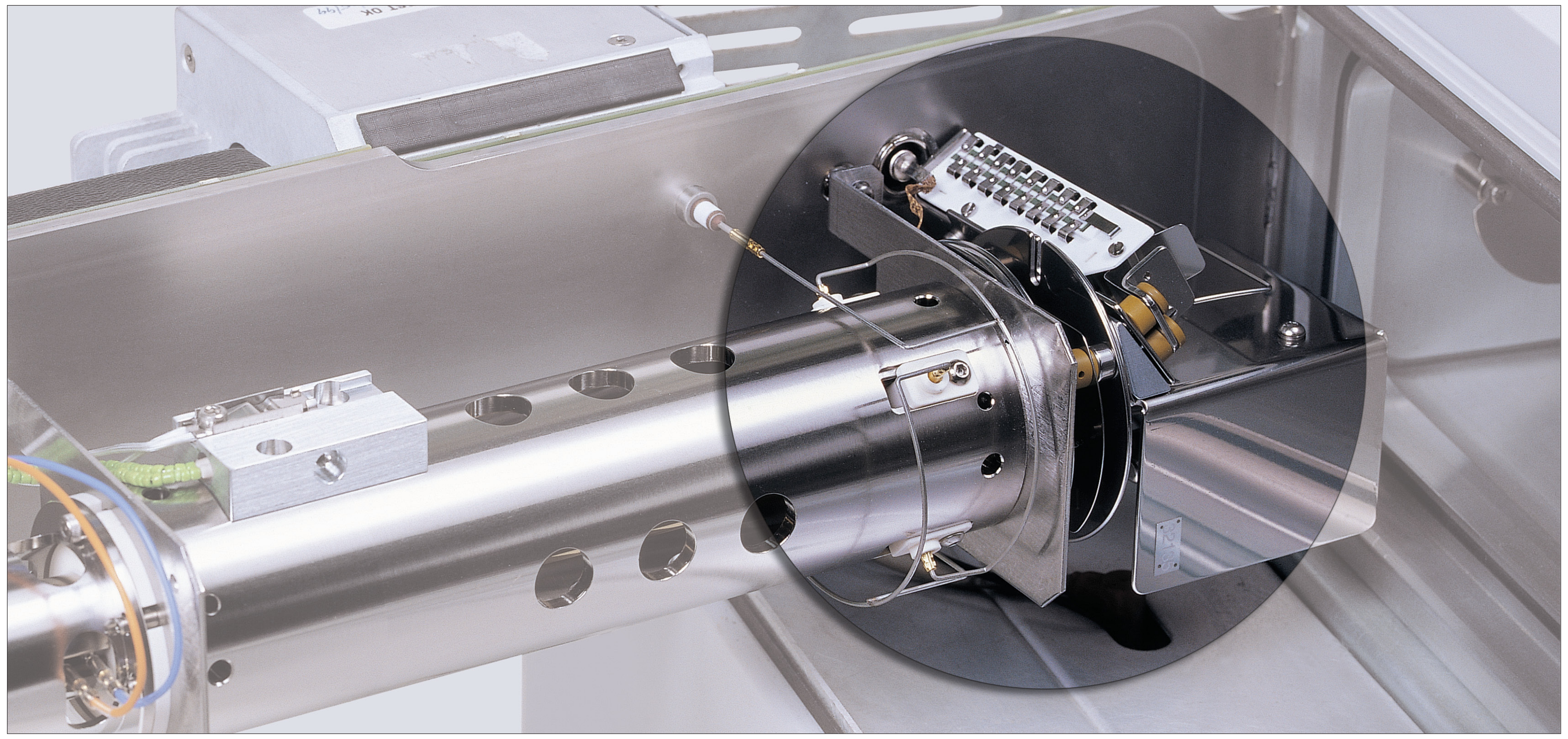


Figure 3. Comparitive linearity data for Tetrachlorophenol.



Performance Comparison

Performance of the ETP detector was compared to the original equipment detector using EPA Method 8270. Figure 3 shows comparative linearity data for Tetrachlorophenol at concentrations ranging from 10mg/mL to 150mg/mL.

Conclusion

A new electron multiplier detector has been designed for the HP/Agilent 5973 MSD that significantly improves system performance for high concentration samples. The new ETP detector incorporates a focused HED and multiple dynode materials to improve both efficiency and operational lifetime. Direct comparison with the detector supplied as original equipment shows that the new ETP detector can improve 5973 system linearity by more than 250%.

Acknowledgement

The author gratefully acknowledge Ms. Carol Lovett of Severn-Trent Laboratories (Austin, Texas) and Larry Garreston of Scientific Instruments Sales and Service (Austin, Texas) for providing GC-MS instrumentation, analytical materials, and production of raw data employed in this study.

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