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This Week's Citation Classic

Taylor N J. Resolution and sensitivity considerations of an Auger electron spectrometer based on display LEED optics. *Rev. Sci. Instr.* **40**:792-804, 1969. [Varian Associates, Palo Alto, CA]

A description is given of the important considerations in the design of a retarding field analyzer based on low-energy electron-diffraction (LEED) optics suitable for Auger electron spectroscopy. Some comparisons are made with a 127° cylindrical electrostatic analyzer. [The SCI® indicates that this paper has been cited over 125 times since 1969.]

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"For several years I had been working on the development of commercial low-energy electron-diffraction equipment (LEED) at Varian. During this time I had the opportunity to carry out some research using the equipment, particularly in the study of the epitaxial growth of metals on 'clean' metal substrates. One of the serious and yet often underestimated problems of LEED work at that time was the uncertainty in the degree of cleanliness of the surfaces under study since the diffraction patterns themselves were influenced by contaminants, sometimes strongly, but often quite subtly and insidiously.

"During the course of a conversation with a professor at an eastern university I learned that workers at the University of Minnesota had used a LEED system as an electron spectrometer, and through an analysis of the Auger-electron spectrum had identified and measured relative amounts of submonolayer levels of material on surfaces.[1] I also learned of pioneering work by L.A. Harris of the General Electric Company,[2] who was probably the one most responsible for demonstrating the power of the technique. He had used a different kind of measuring instrument—a 127° sector electrostatic spectrometer.

"At this time Varian had sold numerous LEED systems throughout the world and to add analysis ability to those systems would greatly increase their effectiveness and would also make good business sense. I had no difficulty in convincing my management that I should immediately start work on a project to investigate both techniques. Within a matter of days I could obtain a gross secondary electron spectrum using LEED optics. I then struggled to obtain and identify in this relatively smooth background the characteristic features of a genuine Auger spectrum of the sample that happened to be in the system, tungsten, I believe. The paper developed quite simply from attempts to answer the questions I asked myself during miserable early attempts to obtain satisfactory spectra. With some embarrassment I recall that a contributing reason for the lack of early success was that, in my haste to get the equipment assembled, connections to a modulation transformer were inverted thereby drastically reducing the intensity of the output signal. I doubt if as much effort and thought would have gone into the sensitivity problem if the wiring had been correct and acceptable results obtained immediately. Industrial development seldom permits in-depth analysis unless the need is paramount.

"For a given energy resolution it turned out that for most practical applications of Auger spectroscopy the LEED optics based spectrometer and the 127° sector did not differ much in sensitivity. In any case they were both rapidly superceded by the cylindrical mirror electrostatic analyzer and to a lesser degree by other gridded schemes.

"Probably the main reason why the paper has been frequently cited is that it answered questions relating to a technique which, for a period at least, was in widespread use. Later, workers could refer to it as a point of reference to show improvements in both analysis and spectrometers."

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1. **Weber R E & Peria W T.** Use of LEED apparatus for the detection and identification of surface contaminants. *J. Appl. Phys.* **38**:4355-58, 1967.
2. **Harris L A.** Analysis of materials by electron-excited Auger electrons. *J. Appl. Phys.* **39**:1419-27, 1968.