

Development of an Analyzer for Auger Photoelectron Coincidence Spectroscopy (APECS) Consisting of a Coaxially Symmetric Mirror Electron Energy Analyzer and a Miniature Double-Pass Cylindrical Mirror Electron Energy Analyzer

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Introduction

Auger electron spectroscopy (AES) is widely used for surface analysis. The study of Auger processes using AES, however, has so far been mainly restricted to major normal-Auger processes. The other elementary Auger processes, such as cascade Auger, shake-up and -off Auger, and site-specific Auger, have not been fully explored. Recently, Auger photoelectron coincidence spectroscopy (APECS) has developed into an ideal tool to elucidate individual Auger processes associated with a specific core-ionization [1]. In this article we report development of a new APECS apparatus that consists of a coaxially symmetric mirror analyzer (ASMA) and a double-pass cylindrical mirror analyzer (DPCMA) with an improved electron-energy resolution [2].

Results and conclusion

Figure 1 shows the miniature DPCMA that we developed. The trajectories of electrons and isoelectric lines were simulated with SIMION 3D version 7.0 (<http://www.simion.com/>). It consists of a shield for the electric field, an inner cylindrical electrode with four meshes, an outer cylindrical electrode, two pinholes with a diameter of 2.0 mm, and an electron multiplier. By assembling the DPCMA in an ASMA coaxially and confocally we developed an analyzer for Auger-photoelectron coincidence spectroscopy (APECS), as shown in Fig. 2.

The APECS apparatus was installed in a multi-purpose ultrahigh vacuum chamber at BL11B. The electron-energy resolution of the DPCMA was estimated to be $E/\Delta E = 20$ by measuring Si 1s photoelectron spectrum at $h\nu = 1880$ eV. The performance of the apparatus was estimated by measuring the Si-LVV-Auger Si-1s-photoelectron coincidence spectra of Si(111), as shown in Fig. 3.

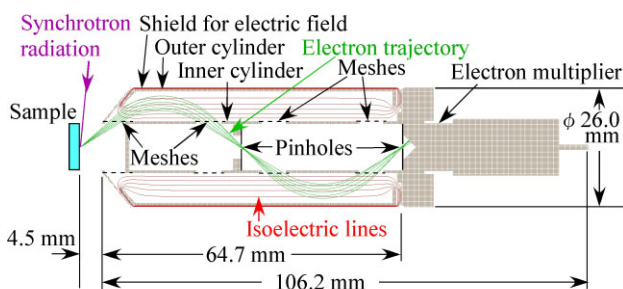


Figure 1. Miniature DPCMA.

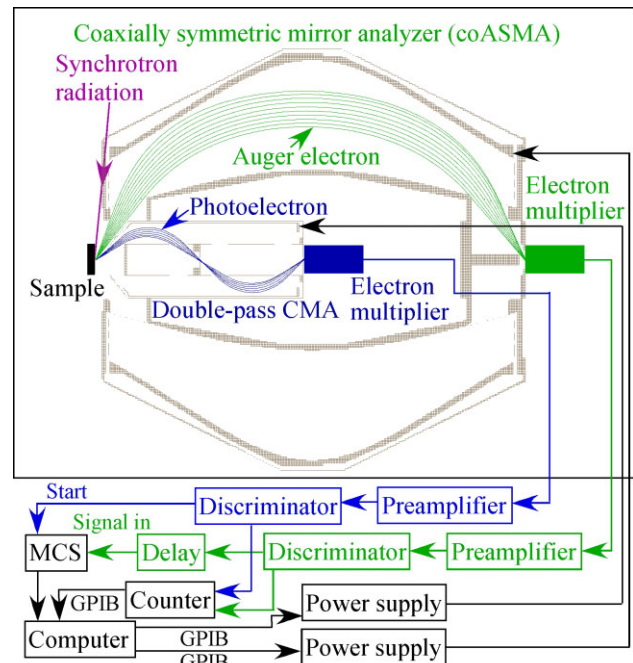


Figure 2. APECS apparatus consisting of an ASMA and a DPCMA.

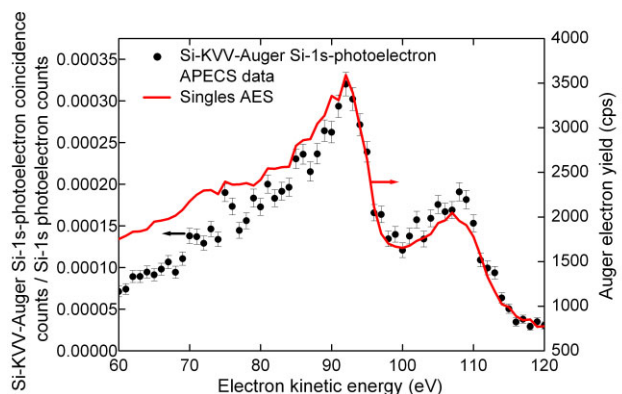


Figure 3. Auger photoelectron coincidence data of Si(111) measured with the APECS apparatus at $h\nu = 1880$ eV. The accumulation time was 120 s per a datum.

References

- [1] H. W. Haak, G. A. Sawatzky and T. D. Thomas, Phys. Rev. Lett. 41 (1978) 1825.
- [2] E. Kobayashi et al., Surf. Sci., submitted.

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