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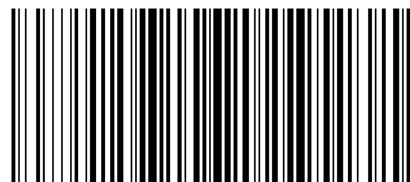

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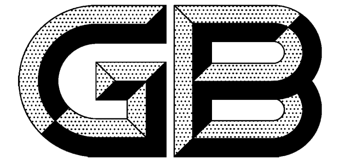

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Standard guide to charge control and charge referencing techniques in X-ray photoelectron spectroscopy

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[15] Edgell, M. J., Baer, D. R., and Castle, J. E., "Biased Referencing Experiments for the XPS Analysis of Non-Conducting Materials," *Applied Surface Science*, Vol 26, 1986, pp. 129-149.

[16] Kelly, M. A., "New Approaches to the Control of Insulator Surface Charging in Surface Spectroscopy," US Patent 5432-345, Invited presentation at the American Vacuum Society National Symposium, Philadelphia, PA, October 1996.

[17] Wagner, C. D., "Energy Calibration of Electron Spectrometers," *Applied Surface Analysis*, *ASTM STP* 699, ASTM, 1980, pp.137-147.

[18] Clark, D. T., Thomas, H. R., Dilks, A., and Shuttleworth, D., "A Method to Reduce the Hydrocarbon Contamination of Samples in X-ray Photoelectron Spectroscopy," *Journal of Electron Spectroscopy and Related Phenomena*, Vol 10, 1977, pp. 455-460.

[19] Swift, P., "Adventitious Carbon—The Panacea for Energy Referencing?" *Surface and Interface Analysis*, Vol 4, 1982, pp. 47-57.

[20] Kohiki, Shigemi and Oki, Kazue, "Problems of Adventitious Carbon as an Energy Reference," *Journal of Electron Spectroscopy and Related Phenomena*, Vol 33, 1984, pp. 375-380.

[21] Clark, D. T., Dilks, A., and Thomas, H. R., "ESCA Applied to Polymers, XXI. Investigation of Sample-Charging Phenomena," *Journal of Polymer Science*: *Polymer Chemistry Edition*, Vol 16, 1978, pp. 1461-1474.

[22] Urch, D. S., and Webber, M., "The Unsuitability of Gold as a Standard for Non-Conducting Samples in X-ray Photoelectron Spectroscopy," *Journal of Electron Spectroscopy and Related Phenomena*, Vol 5, 1974, pp. 791-798.

[23] Hnatowich, D. J., Hudis, J., Perlman, M. L., and Ragaini, R. C., "Determination of Charging Effect in Photoelectron Spectroscopy of Nonconducting Solids," *Journal of Applied Physics*, Vol 42, No. 12, 1971, pp. 4883-4886.

[24] Kohiki, S., "Problem of Evaporated Gold as an Energy Reference in X-ray Photoelectron Spectroscopy," *Applications of Surface Science*, Vol 17, 1984, pp. 497-503.

[25] Kohiki, S., and Oki, K., "An Appraisal of Evaporated Gold as an Energy Reference in X-ray Photoelectron Spectroscopy," *Journal of Electron Spectroscopy and Related Phenomena*, Vol 36, 1985, pp. 105-110.

[26] Kohiki, S., Ohmura, T., and Kusao, K., "A New Charge—Correction Method in X-ray Photoelectron Spectroscopy," *Journal of Electron Spectroscopy and Related Phenomena*, 28, No. 4, 1983, pp. 229-237.

[27] Citrin, P. H., and Hamann, D. R., "Measurement and Calculation of Polarization and Potential—Energy Effects on Core-Electron Binding Energies in Solids: X-ray Photoemission of Rare Gases Implanted in Noble Metals," *Physics. Rev.* Vol B10, 1974, p. 494B.

[28] Sambe, H., and Ramaker, D. E., "X-ray Photoelectron Spectroscopy Study on the Electrical Double Layer at an Al_2O_3—Al Interface," *J. Vac. Sci. Technol.*, A10, 1992, pp. 2991-3005.

[29] Baer, D. R., Engelhard, M. H., Schulte, D.W., Guenther, D. E., Wang, L-Q., and Rieke, P. C., "Electron Beam Effects on (CH_2)17 Self—Assembled Monolayer SiO_2/Si Specimens," *J. Vac. Sci. Technol.*, A12, 1994, pp. 2478-2485.

[30] Wagner, C. D., "Chemical Shifts of Auger Lines, and the Auger Parameters," *Faraday Discussions of the Chemical Society*, No. 60, 1975, pp. 291-300.

前　言

本标准按照 GB/T 1.1—2009 给出的规则起草。

本标准由全国半导体设备和材料标准化技术委员会(SAC/TC 203)提出并归口。

本标准起草单位:信息产业专用材料质量监督检验中心、中国电子技术标准化研究院、苏州晶瑞化学有限公司、天津中环领先材料技术有限公司。

本标准主要起草人:李雨辰、何秀坤、刘筠、刘兵、李翔。

引　言

X射线光电子能谱用于固体材料表面元素组成和元素化合态的测试与表征，通过某一元素结合能的细微变化可获得该元素化合态信息。

对于绝缘样品表面，X光激发的光电子发射会导致表面正电荷积累，改变表面电势，因此使测得的光电子谱峰位向高结合能偏移。表面感生电荷的数量、在样品表面的分布及其与试验条件的依赖关系决定于许多因素，包括样品成分、样品的均匀性、表面电导率、总光致电离截面、表面形貌、激发X光的特殊空间分布、中和电子等。荷电积累是发生在样品表面和材料内部的三维现象。

本标准描述了各种已经或即将用于采集和解析绝缘样品表面的X射线光电子能谱数据的荷电控制与针对荷电偏移的校正方法，目的是通过控制荷电积累，校正由于表面充电引起的结合能飘移，以得到有意义且可重现的绝缘样品的测试数据。

参　考　文　献

［1］ Cazaux，Jacques，“Mechanics of Charging in Electron Spectroscopy，”*Journal of Electron Spectroscopy and Related Phenomena*，Vol 105，1999，pp. 155-185.

［2］ Cazaux，Jacques，“About the Charge Compensation of Insulating Samples in XPS，” *Journal of Electron Spectroscopy and Related Phenomena*，Vol 113，2000，pp. 15-33.

［3］ Bart，F.，Guitter，M. J.，Henriot，M.，Thromat，N.，Gautier，M，and Durand，J. P.，“Surface Analysis of Wide Gap Insulators With XPS，” *Journal of Electron Spectroscopy and Related Phenomena*，Vol 69，1994，pp. 245-248.

［4］ Unger，W. E. S.，Gross，T.，Bose，O.，Lippitz，A.，Fritz，T.，and Gelius，U.，“VAMAS TWA2 Project A2：Evaluation of static charge stabilization and determination methods in XPS on non-conducting samples. Report on an inter-laboratory comparison，” *Surface and Interface Analysis*，Vol 29，2000，pp. 535-543.

［5］ Dickinson，T.，Povey，A. F.，and Sherwood，P. M. A.，“Differential Sample Charging in ESCA，” *Journal of Electron Spectroscopy and Related Phenomena*，Vol 2，1973，pp. 441-447.

［6］ Swift，P.，Shuttleworth，D.，and Seah，M. P.，“Static Charge Referencing Techniques，” *Practical Surface Analysis*，John Wiley and Sons，Ltd.，New York，NY，1983，pp. 437-444.

［7］ Johansson，G.，Hedman，J.，Berndtsson，A.，Klasson，M.，and Nilsson，R.，“Calibration of Electron Spectra，” *Journal of Electron Spectroscopy and Related Phenomena*，Vol 2，1973，pp. 295-317.

［8］ Huchital，D. A.，and McKeon，R. T.，“Use of an Electron Flood Gun to Reduce Surface Charging in X-ray Photoelectron Spectroscopy，” *Applied Physics Letters*，Vol 20，No. 4，1977，pp. 158-159.

［9］ Hunt，C. P.，Stoddart，C. T. H.，and Seah，M. P.，“The Surface Analysis of Insulators by SIMS：Charge Neutralization and Stabilization of the Surface Potential，” *Surface and Interface Analysis*，Vol 3，No. 4，1981，pp. 157-160.

［10］ Lewis，R. T.，and Kelly，M. A.，“Binding-Energy Reference in X-ray Photoelectron Spectroscopy of Insulators，” *Journal of Electron Spectroscopy and Related Phenomena*，Vol 20，1980，pp. 105-115.

［11］ Bryson，C. E.，“Surface Potential Control in XPS，” *Surface Science*，Vol 189/190，1987，pp. 50-58.

［12］ Clark，D. T.，“The Investigation of Polymer Surfaces by Means of ESCA，” *Polymer Surfaces*，John Wiley and Sons，Ltd.，New York，NY，1978，pp. 309-351.

［13］ Tielsch，B. J.，and Fulghum，J. E.，“Differential Charging in XPS. Part Ⅲ. A Comparison of Charging in Thin Polymer Overlayers on Conducting and Non-Conducting Substrates，” *Surface and Interface Analysis*，Vol 25，1997，pp. 904-912.

［14］ Thomas Ⅲ，J.，“Photon Beam Damage and Charging at Solid Surfaces，” in *Methods of Surface Characterization*，Vol 4：*Beam Effects*，*Surface Topography*，*and Depth Profiling in Surface Analysis*，edited by A. Czanderna，C. J. Powell，and T. E. Madey，Plenum Publishing Corporation，NY (1998).