O23 |

Slow positron annihilation spectroscopy of mesoporous silicon oxide films obtained by electro-assisted self-assembly

B. Y. Wang[1,*], C. Q. He[2], X. W. Zhang[2], P. Kuang[1], and X. Z. Cao[1]

[1] *Institute of High Energy Physics, Chinese Academy of Sciences, 100049 Beijing, China*
[2] *School of Physics and Technology, Wuhan University, Wuhan, 430072 Hubei, China*

*email: wangboy@ihep.ac.cn

Supported mesostructured thin films are of major importance for applications in optical, electrochemical and sensing devices. Highly ordered and vertically oriented mesoporous silica oxide films can be generated by electro-assisted self-assembly (EASA). The method involves the electrogeneration of hydroxide ions at an electrode surface immersed in an hydrolyzed sol solution (containing typically tetraethoxysilane, TEOS, and cetyltrimethylammonium bromide, CTAB) in order to catalyze polycondensation of the precursors and self-assembly of hexagonally packed one-dimensional channels that grow perpendicularly to the support (ITO). Thickness of these films can be accurately controlled by applying galvanostatic conditions and by varying the deposition time. However, the influence of the CTAB/TEOS concentration ratio on the mesoporous structure has never been thoroughly examined. Slow positron annihilation spectroscopy is a powerful tool to study in-depth variation of membrane fine structural. In this paper, we report a combined study of the Doppler broadening (DBES) and positron annihilation lifetime spectroscopy (PALS) methods coupled with variable monoenergy slow positron beams to study the positron annihilation characterization in mesoporous silicon oxide films (200nm) formed with four different CTAB/TEOS ratios. The S-W curve shows that there are three straight line segments, respectively, corresponding to the three transition regions of the film. Obviously, the S parameter of the transition zone from the silicon oxide film to the interface between the silicon oxide and the ITO significantly changes with different CTAB/TEOS ratios, indicating the mesoporous structure of films can be well regulated by modifying its ratio. The long lifetime of positron lifetime spectra correlating to magnitude of nanosecond order indicates that the film of CTAB/TEOS ratio 0.04 has the largest mesoporous size.

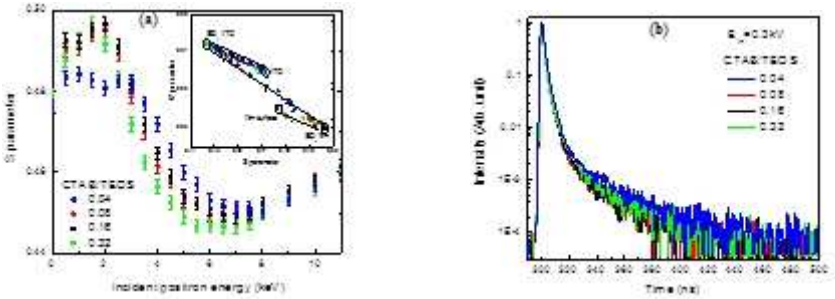

Fig (a). S parameter and S-W plot of 200nm-thin films. Arrows show the incident positron energy E_{in} from 0.012 keV to 10 keV; Fig (b). The PALS with when incident positron energy was 0.3 keV.

Acknowledgements

This work is supported by National Natural Science Foundation of China (11575205).

[1] Yamaguchi, A. et al. *Nature Mater.* **3**, 337–341 (2004)
[2] Deepa, P. N., Kanungo, M., Claycomb, G., Sherwood, P. M. A. & Collinson, M. M. *Anal. Chem.* **75**, 5399–5405 (2003)