O26 |

Porosimetry of ultra-low K materials and transformed porous glass-thin layers by Monenergetic Positron Source at ELBE facility

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The pore size of spin-on coated ultra-low K (ULK) materials cured at 450^{0}C for different times was studied by the pulsed slow positron beam (MePS) at ELBE/HZDR. To investigate the pore formation in cured porous spin-on dielectrics, the pore size as a function of positron implantation energy was obtained for samples with different curing times. Such a study is performed to understand the dielectric damage behaviour of ULK dielectrics for the integration in Back-End of Line (BEOL). MePS results revealed that the films contain open and closed pores with ~ 3 nm in diameter which was confirmed by capping the samples. The highest pore concentration is located beneath the surface in the 0.2 - 0.5 μm range (We plan to carry out ellipsometric porosimetry and FTIR during this summer). Pseudomorphic transformation of porous glass-thin layers, with pores of 40 - 50 nm diameter and a relatively small surface area, to MCM-41 with ~4 nm pores, with a higher surface area, was studied by MePS. The small pore size of MCM-41 was successfully detected with an intensity growth with transformation degree but the large pores were not detected at all. To understand the disability of detecting the large pores by positron annihilation lifetime, we plan to perform SEM measurements in the same depth as that of the implanted positrons (0.005-2.4 μm). Additionally, the increase in the intensity of positronium lifetime, which correlates the small pores, as a function of positron implantation energy could reflect inner pore isolation or poor interconnectivity.