

Pore Size/Distribution and Its Control of Ultra-Low K MSQ/Porogen Material Systems for < 22 nm Backend Interconnects in Microelectronic Applications

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In GISAXS data, the information of pores (open pores and interconnect pores) could be appeared by scattering patterns indirectly. The patterns of scattering show the intensity of scattering. For example, when the matrix including small or well-disperse second phase (in our case, the second phase are open pores and interconnect pores), the pattern would show high intensity (far away from the center) of scattering. Because the second phase small and well-disperse, the better signals could be collected by GISAXS. The figure 1 is typical GISAXS scattering patterns. The figure 1-1 and 1-2 show large pores and small pores individually. In the figure 1-1 (large pores, about 500nm), we would observe pattern approach the center. In the other hand, the figure 1-2 (small pores, about 50nm) shows dispersed scattering patterns far away from the center.

In our research, we would discuss the relationship between the heating rates and the character of pores. We try to use two kinds of heating rates ($2^{\circ}\text{C}/\text{min}$ to 250°C for 1hr and direct 250°C for 1hr) to remove porogen. The Figure 2-1 shows the fast heating rate (direct 250°C for 1hr) to remove porogen. The uncertain variation was observed, and that showed the fast heating rate can avoid the aggregation of porogen. The Figure 2-2 shows the slow heating rate ($2^{\circ}\text{C}/\text{min}$ to 250°C for 1hr) to remove porogen. The pattern apparently changed by temperature raised, and that indicated the aggregation of second phase (porogen) in slow heating rate.

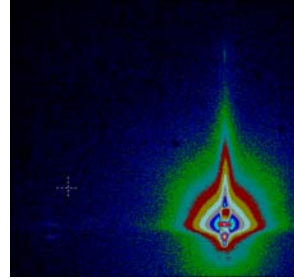


Figure 1-1. GISAXS pattern for large pores.

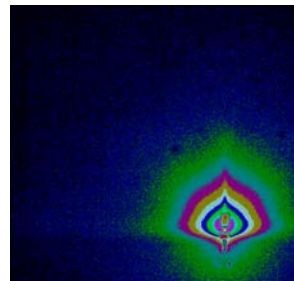


Figure 1-2. GISAXS pattern for small pores.

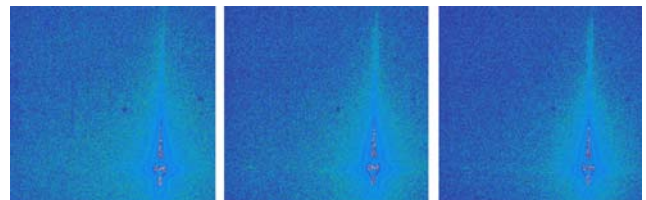


Figure 2-1 The fast heating rate (direct 250°C for 1hr) to remove porogen. (a) 50°C - 70°C ; (b) 130°C - 150°C ; (c) 150°C - 170°C

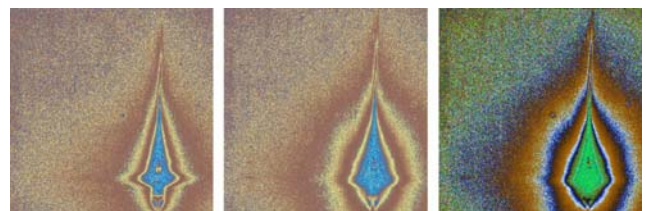


Figure 2-2 The slow heating rate ($2^{\circ}\text{C}/\text{min}$ to 250°C for 1hr) to remove porogen. (a) 50°C - 70°C ; (b) 130°C - 150°C ; (c) 150°C - 170°C