

World Premier Spin-on Dielectrics for System LSI

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System LSI such as microprocessors needs interlayer dielectric materials(insulator) for multi-level Cu wires(interconnects). The best way to lower dielectric constant is to put nano-sized air bubbles into dielectric materials. However, the incorporated pores lead to lowered dielectric constants of nanoporous films but seriously decrease their mechanical properties such as elastic modulus and hardness. Therefore, it is tremendously important to minimize the decrease in the mechanical strengths by controlling pore morphologies like pore size and its size distribution. Semiconductor industry has used CVD-based dielectrics such as Black Diamond II(k~2.5) and III(k~2.3) down to 21nm devices(2015). But it is expected that CVD-ones will be no longer used for the next generation devices due to difficulty in controlling aggregation of pores at higher porosity. Therefore, spin-on dielectrics could be the only solution to further lower the dielectric constant while maintaining mechanical properties. Our group developed spin-on dielectrics based on reactive porogens which can be involved in the reaction with organosilicates during their sol-gel reaction. We obtained world-best nanoporous ultralow dielectrics with 9.1 GPa at dielectric constant of 2.12.