Molecular network reinforcement of sol-gel glasses applications in the microelectronics industry

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The intrinsic mechanical properties of a given material strongly depend upon its chemical nature: the organics tend to be soft, but tough, while the inorganic materials, on the other hand, are hard but brittle, and are prone to fracture. The later characteristic gets even worse for porous materials and is of major concern in the microelectronics industry as porous organosilicates (mainly inorganic) will constitute the next insulating layers in future electronic devices.[1]

In this presentation, we demonstrate that significantly tougher organosilicates glass thin-films prepared by sol-gel process, can be obtained by introducing carbon bridging units between silicon atoms present in the organosilicate network.[2-4]

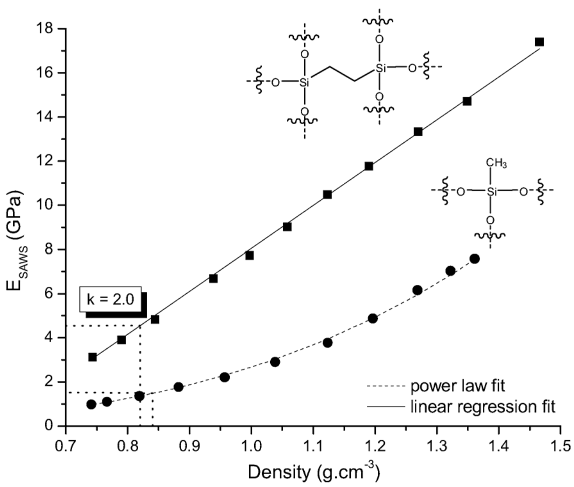

Figure 1. Young's modulus for MSSQ-SiO_2 and Et-OCS films as a function of density.

Fracture energy values of 14–16 J.m^{-2} were measured, surprisingly higher than those for dense silicon dioxide (10 J.m^{-2}), suggesting mechanical properties that lie somewhere in between those of conventional glasses and organic polymers. We also found that the Young's modulus follows a linear decay when porosity is introduced, a unique property when compared to traditional organosilicates.[3]

As a result, crack resistant films were obtained at high level of porosity, opening potential applications in the field of low-*k* materials for future integrated circuits, membranes, sensors, waveguides, fuel cells and micro-fluidic channel.

References

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