


## Comparison of techniques to characterise the density, porosity and elastic modulus of porous low-*k* SiO<sub>2</sub> xerogel films

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### Abstract

A range of mesoporous xerogel low-*k* dielectric films were prepared and characterised using complementary techniques: Laser-generated surface acoustic waves, ellipsometric porosimetry, Rutherford backscattering and nanoindentation. The density, porosity, pore size distribution, cumulative surface area, elastic modulus and hardness of the films were measured as well as their dielectric constants. Dielectric constant values of  $k=1.7$ – $2.3$  were measured for samples with porosities of 36–55%. Mean pore radii values of 2.2–4.2 nm and surface areas of 280–240 m<sup>2</sup> cm<sup>-3</sup> were also obtained. Using porosity and mean film density values determined using different techniques, the film skeletal density of these samples were calculated to be  $\approx 1.4$  g cm<sup>-3</sup>, almost 40% lower than that of dense SiO<sub>2</sub>. The elastic moduli of the films were found to be  $E < 4$  GPa.

**Author Keywords:** Xerogel; Thin film; Low-*k* dielectric; Porous; SiO<sub>2</sub>; Spin-on; Characterisation; Porosity; Elastic modulus

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