

Structural and Electrical Characteristics of Low-Dielectric Constant Porous Hydrogen Silsesquioxane for Cu Metallization

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The structural and electrical properties of porous hydrogen silsesquioxane (XLK) have been characterized using a combination of Fourier transform infrared spectroscopy (FTIR), transmission electron microscope (TEM), Auger electron spectroscopy (AES), current-voltage analyzer and capacitance-voltage analyzer. The pores, about 3 nm in size and of spherical shape, were distributed randomly and uniformly in the XLK film and the porosity appears to be predominately closed cell in nature as shown in Fig. 1. The dielectric constant of XLK film was as low as 2.1 owing to the high porosity and uniformity of the film. A smooth amorphous-like layer including Cu-O-Si was found to form between Cu and the XLK film after annealing at 500 °C for 30 min as shown in Fig. 2. The mixed layer led to the higher leakage current of the XLK film. Cu was found to diffuse into XLK film after annealing at 600 °C for 30 min as shown in Fig. 3.

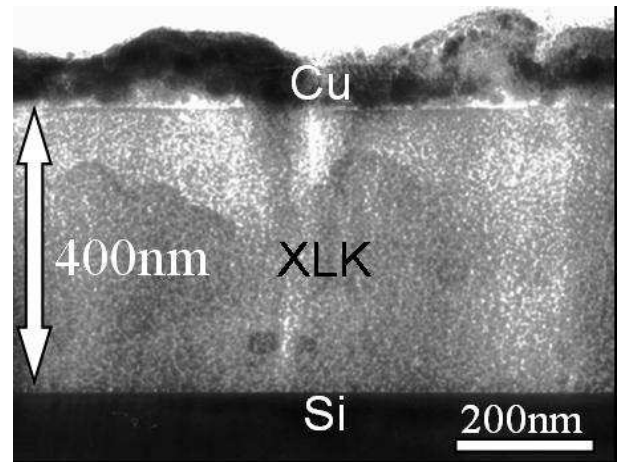


Fig. 1. XTEM micrograph of an as-deposited Cu/XLK/Si sample.

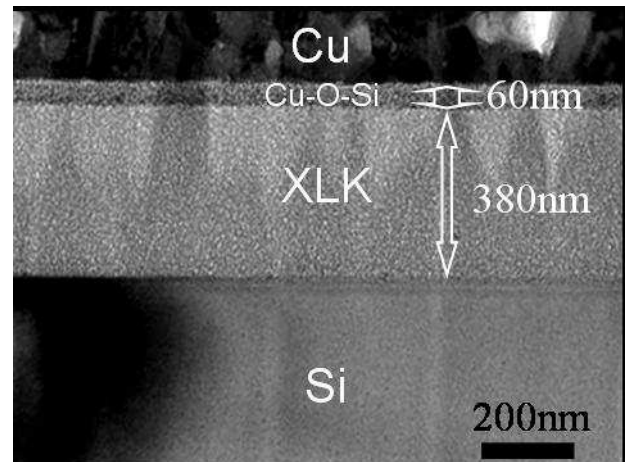


Fig. 2. XTEM micrograph of a Cu/XLK/Si sample annealed at 500 °C for 30 min.

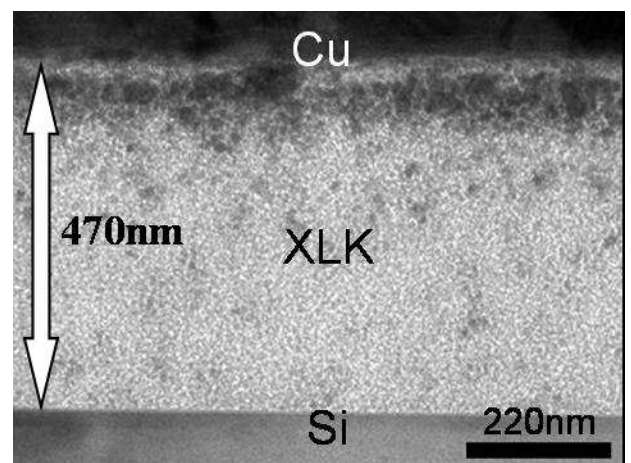


Fig. 3. XTEM micrograph of a Cu/XLK/Si sample annealed at 600 °C for 30 min.