Low dielectric constant plasma polymerized SiCOH film deposited from tetrakis(trimethylsilyoxy)silane as a flexible insulator

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As a flexible display has been developed, the insulator film of new material has been needed on the flexible display process. Although the silicon oxide (SiO_2) film has excellent insulator properties, the high temperature process andbrittle property of the SiO_2 film were not suitable for the flexible insulator film. The plasma polymerized SiCOH films have been used for inter-metal and inter-layer dielectric on the semiconductor process because they have lowdielectric constants of SiCOH (relative dielectric constant $k \leq 4.0$) to reduce resistance x capacitance (RC) delay. The structural property of SiCOH is more porous than SiO_2. In this study, the low-k properties of plasma polymerized SiCOH films before and after bending test were investigated in order to confirm applicability to the flexible insulator thin film. The SiCOH films were deposited by plasma enhanced chemical vapor deposition with the tetrakis(trimethylsilyoxy)silane precursor on the indium tin oxide (ITO)/polyethylene naphthalate (PEN) substrate. The deposition plasma power was changed from 20 to 80 W, and the thickness of deposited films was about 300nm. In order to investigate the electrical propertiesof the SiCOH films before and after bending test, flexibility tests of thedeposited SiCOH films were performed using a motor controllable motion controller with 1,000, 5,000, 10,000 cycles. The dielectric constants were not much changed after bending test for the films deposited at the powers of 20 and 40W. However, for the films deposited at the powers of 60 and 80W, thedielectric constants increased as the number of bending cycles increased. It is assumed that bending of SiCOH films could affect the cross-linked complex structure and therefore the density of the film. The leakage current did not increase significantly and the transmittance remained at 95.14-99.35 %of the substrate value with increased bending cycles, appropriate for a flexible insulator.