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Synthesis and Characterization of Ethylene-Bridged Silsesquioxane Thin Films for Gate Insulator

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There have been efforts since 1980 in order to increase the mobility and I_{on}/I_{off} ratio of organic thin film transistor (OTFT). Silicon oxide (SiO_2)has been used as gate insulator in OTFT. But its hydrophilic surface makes it is difficult to spin organic semiconductor on gate insulator. Additionally, it is proved that gate insulator possessing hydrophobic surface improves the crystality of semiconductor structure. So, SiO_2 is usually modified by hexamethyldisilazane (HMDS) in order to get hydrophobic surface. In current work, we investigate alternative thin films that could be candidate for gate insulator. Ethylene-bridged copolymer was synthesized from two monomers: 1,2-bis(trimethoxysilyl) ethane and methyltrimethoxysilane. Copolymer thin films were fabricated by spin coating above copolymer resin on silicon wafer followed by HMDS treatment. The composition of functional groups in copolymer including [Si-OH], [Si-CH_2-CH_2-Si],[Si-CH_3] and [Si-OCH_3] was estimated by nuclear magnetic resonance (NMR) and Fourier transform infrared spectroscopy (FTIR) from the resin type of copolymer. Metal insulator metal (MIM), metal insulator semiconductor (MIS) devices were made to investigate the electrical properties of copolymer thin films. The mobility of copolymer as gate insulator was also thoroughly characterized through OTFT device employing P3HT as organic semiconductor. The results show that dielectric properties and the mobility are depending on the functional groups composition. The high mobility of copolymer in comparison with the classical HMDS modified SiO_2 implies that this type of material could meet required properties for good gate insulator.