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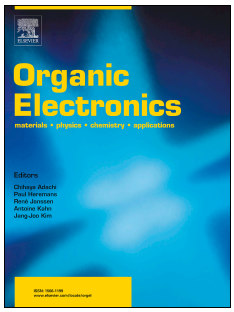

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Ladder-Type Silsesquioxane Copolymer Gate Dielectrics for Gating Solution-Processed IGZO Field-Effect Transistors

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ABSTRACT Field-effect transistors (FETs) based on solution-processed indium-gallium-zinc oxide (IGZO) exhibited excellent electrical properties, including a high carrier mobility over 1 $cm^2/V{\cdot}s$ and an on/off current ratio over 10^7. Solution-processable gate dielectric materials with excellent electrical strength were required instead of inorganic oxide gate dielectrics such as SiO_2, Al_2O_3, and HfO_2. In this manuscript, we demonstrated the use of a ladder-type poly(phenyl-*co*-methacryl silsesquioxane) (PPMSQ) copolymer as a gate dielectric in IGZO FETs. Methacryloxypropyl groups in the copolymer were introduced to crosslink the polymer chains via thermal annealing. Thermal annealing at 200 °C enhanced the electrical strength of the gate dielectric layer because of the formation of a network structure with a reduced free volume. The resulting IGZO FETs based on 200 °C-annealed ladder-type PPMSQ gate dielectrics exhibited an electron mobility of 1.2 (±0.05) $cm^2/V{\cdot}s$, a threshold voltage of 17 (±2) V, and an on/off current ratio of 1.5 (±0.7) × 10^8. The use of the polymeric ladder-type PPMSQ gate dielectrics for gating the IGZO FETs provided a novel approach to realizing future flexible electronics.

Keywords: ladder-type poly(phenyl-co-methacryl silsesquioxane), gate dielectric, indium-gallium-zinc oxide, transistor, crosslink