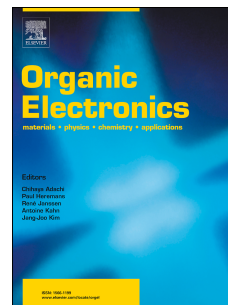


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Ladder-Type Silsesquioxane Copolymer Gate Dielectrics for Gating Solution-Processed IGZO Field-Effect Transistors

Min Je Kim,¹ Young Min Heo,^{3,4} Jeong Ho Cho^{1,2*}

¹SKKU Advanced Institute of Nanotechnology (SAINT), ²School of Chemical Engineering, Sungkyunkwan University, Suwon 440-746, Republic of Korea

³Department of Chemical and Biomolecular Engineering, Sogang University, Seoul, Republic of Korea

⁴SKC Advanced Technology R&D Center, Suwon, Gyeonggi-do 440-301, Republic of Korea

*E-mail: jhcho94@skku.edu

ABSTRACT Field-effect transistors (FETs) based on solution-processed indium-gallium-zinc oxide (IGZO) exhibited excellent electrical properties, including a high carrier mobility over $1 \text{ cm}^2/\text{V}\cdot\text{s}$ 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 $1.2 (\pm 0.05) \text{ cm}^2/\text{V}\cdot\text{s}$, a threshold voltage of $17 (\pm 2) \text{ V}$, and an on/off current ratio of $1.5 (\pm 0.7) \times 10^8$. 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

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