Low Temperature Fabricated Organic-InorganicHybrid Insulator for Thin Film Transistors

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Over the few decades, flexibleelectronics have been extensively studied focusing on organic or polymer basedelectronic materials such as organic semiconductors, conducting polymers andpolymer dielectrics. These materials offer compatibility with flexible plasticsubstrates, as well as large area coverage, low cost and low temperaturefabrication processes. In the case of polymer dielectrics, they suffer highleakage current density and poor dielectric characteristics compared toinorganic materials, which leads to relatively high operating voltage of thinfilm transistors (TFTs). Many approaches are being made to overcome theweaknesses of polymer dielectrics and one of those approach is to combine organic-inorganicmaterials in various ways as hybrid gate dielectrics.

In this paper, organic-inorganichybrid gate dielectrics were fabricated by directly blending polymer solutionand inorganic precursor solution. The organic solution was prepared by dissolvingPVP-co-PMMA (Poly(4-VinylPhenol-co-MethylMethAcrylate)) and PMF (Poly(Melamine-co-Formaldehyde))in ethyl alcohol. To improve the performance of the dielectric, we have chosen thehigh-k ZrO_2 prepared by solution for the inorganic material. The inorganicprecursor solution for ZrO_2 was prepared by dissolving $ZrCl_4$,HNO_3 and H_2O in ethyl alcohol. The two solutions wereblended, spin-coated and thermally annealed after UV treatment.Metal-insulator-metal (MIM) structures were fabricated using the dielectriclayer. We obtained a low leakage current density (J_g) of 9.49E-8A/cm^2 (at 1 MV/cm), a high breakdown field (E_{br}) of 5.99MV/cm and a high dielectric constant of 5.62 via additional UV treatmentcompared with the only thermal annealing.