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Organic thin film transistor with PVP-$BaTiO_3$ nanocomposite gate dielectric layer

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In organic thin film transistor devices, obtaining good dielectric characteristics and mechanical flexibility simultaneously has been a question of great interest. In order to achieve high on/off ratio, the leakage current should be low enough. For this purpose, nanocomposite can be a useful choice for the gate dielectric layer. Because of high dielectric constant and high thermal stability, in this work, barium titanate ceramic particles ($BaTiO_3$) were used as the filler in the polymer matrix of poly 4-vinyl phenol (PVP). A kind of coupling agent was applied on to $BaTiO_3$ particles before dispersing in the polymer to form PVP-$BaTiO_3$ nanocomposite. The thickness of this dielectric layer was 400 nm. The AFM images showed that the surface roughness of the nanocomposite layer increases with the increase of $BaTiO_3$ content. This is due to the agglomeration of the particles. The surface roughness was about 3 nm for the sample with 25 wt% of $BaTiO_3$. For the flexibility test of the dielectric layer, the cyclic bending experiment was carried out. Leakage current of the sample was measured before and after bending test. Compared to the results before bending, the leakage current of the samples after being bended was higher. However, the leakage has not increased when the number of cyclic bending was increased. Nanocomposite gate dielectric layer was shown to have higher capacitance and lower leakage current compared to those of pure PVP gate dielectric layer.

Keywords: nanocomposite, coupling agent

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Temperature dependence of photoluminescence of InAs quantum dots with InxGa1-xAs overgrowth layer.

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Self-assembled InAs/GaAs quantum dots (QDs) have been intensively investigated because of their potential for the optoelectronic devices such as QD's diode lasers which have higher differential gain, lower threshold current density and higher thermal stability compared with other low-dimension quantum structures, due to the atomic-like density of state in QD system. We have investigated the temperature dependence of the PL spectra for the self-assembled InAs QDs with an asymmetric InGaAs QW. The excited-state transition for the InAs QDs with an asymmetric InGaAs QW with increasing temperature almost not appeared due to the large energy-level spacing between the ground states and the first excited states. The PL peak position of the samples with an asymmetric InGaAs QW was definitely more red-shifted with increasing temperature, compared to the reference sample. Temperature-dependent PL shows that the FWHMs of the samples with In modulation $In_xGa_{1-x}As$ overgrowth layer were keeping nearly constant in the temperature range of 20−200 K. The thermal activation energy of the electron-hole emission for the InAs QDs with an asymmetric InGaAs QW was considerably decreased, compared to the InAs QDs without that. The InAs QDs with graded $In_xGa_{1-x}As$ overgrowth layer will be promising for the device applications such as 1.3 µm QD-based lasers and 1.3 µm optical-fiber communication.

Keywords: Photoluminescence, InAs, Quantum dots