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Enhanced Electrical Properties of Light-emitting Electrochemical Cells Based on PEDOT:PSS incorporated Ruthenium(II) Complex as a Light-emitting layer

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Ionic Transition Metal Complex based (iTMC) Light-emitting electrochemical cells (LEECs) have been drawn attention for cheap and easy-to-fabricate light-emitting device. LEEC is one of the promising candidate for next generation display and solid-state lighting applications which can cover the defects of current commercial OLEDs like complicated fabrication process and strong work-function dependent sturucture. We have investigated the performance characteristics of LEECs based on poly (3, 4-ethylenedioxythiophene):poly (styrene sulfonate) (PEDOT:PSS)-incorporated transition metal complex, which is tris(2, 2'-bipyridyl)ruthenium(II) hexafluorophosphate in this study. There are advantages using conductive polymer-incorporated luminous layer to prevent light disturbance and absorbance while light-emitting process between light-emitting layer and transparent electrode like ITO. The devices were fabricated as sandwiched structure and light-emitting layer was deposited approximately 40nm thickness by spin coating and aluminum electrode was deposited using thermal evaporation process under the vacuum condition (10-3Pa). Current density and light intensity were measured using optical spectrometer, and surface morphology changes of the luminous layer were observed using XRD and AFM varying contents of PEDOT:PSS in the Ruthenium(II) complex solution. To observe enhanced ionic conductivity of PEDOT:PSS and luminous layer, space-charge-limited-currents model was introduced and it showed that the performances and stability of LEECs were improved. Main discussions are the followings. First, relationship between film thickness and performance characteristics of device was considered. Secondly, light-emitting behavior when PEDOT:PSS layer on the ITO, as a buffer, was introduced to iTMC LEECs. Finally, electrical properties including carrier mobility, current density-voltage, light intensity-voltage, response time and turn-on voltages were investigated.