Optically Transparent Cathode for Dye Sensitized Solar Cells Based on Graphene Nanoplatelets

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Commercial graphene nanoplatelets exhibit promising electrocatalytic activity towards I_3^-/I^- redox couple in thin films which are optically semitransparent. Electrochemical impedance spectra confirm that the charge-transfer resistance, R_{CT} is smaller by a factor of 5-6 in ionic liquid electrolyte (Z952) compared to that in traditional electrolyte in methoxypropionitrile solution (Z946). The difference was attributed to solvation-related events, rather than viscosity-control of the charge transfer mechanism. In both electrolytes tested (Z946, Z952) the R_{CT} scaled linearly with the graphene film's absorbance, confirming a simple proportionality between the concentration of active sites (edge defects and oxidic groups) and electrocatalytic properties of the electrode for I_3^-/I^- redox reaction (Figure 1).

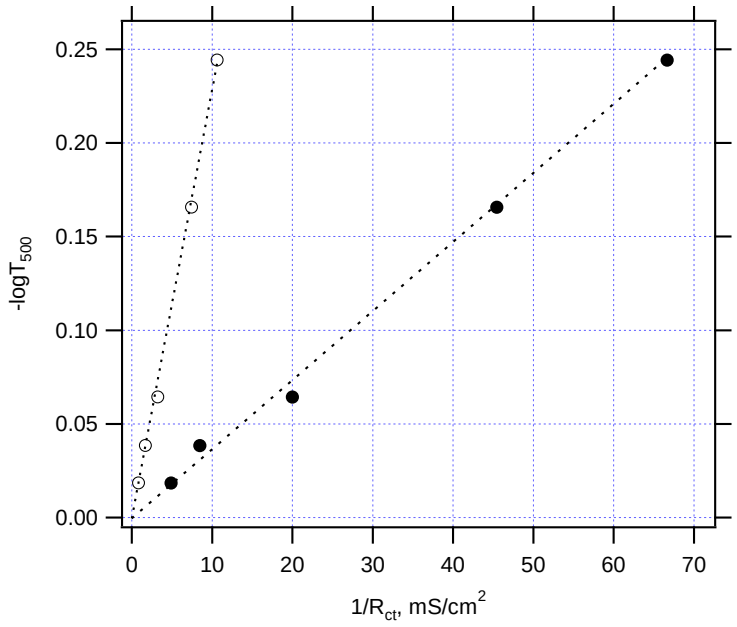

Figure 1. *Optical absorbance of graphene at a wavelength of 500 nm plotted as a function of inverse charge transfer resistance determined from electrochemical impedance spectra in volatile electrolyte, Z946 (open points) and in ionic liquid electrolyte, Z952 (full points).*

Solar efficiency tests confirmed that semitransparent film of graphene nanoplatelets presented no barrier to drain photocurrents at 1 Sun illumination and potentials between 0 to *ca.* 0.3 V. Consistent

with the impedance data on symmetrical dummy cells, the graphene cathode exhibited better performance in DSC with ionic liquid electrolyte (Z952). Nevertheless, the R_{CT} of graphene nanoplatelets still needs to be decreased *ca.* 10 times to improve the behavior of DSC near the open circuit potential and, consequently, the fill factor. Our study points at an optimistic prediction that all-carbon cathode (FTO and Pt-free) is eventually accessible from graphene composites.

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