



# Electro-catalytic and structural studies of DNA templated gold wires on platinum/ITO as modified counter electrode in dye sensitized solar cells

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## Abstract

DNA templated gold wires (AuWs) were fabricated on Pt sputtered ITO (Pt/ITO) substrates using ‘scribing’ or ‘writing’ method to be used as a modified counter electrode (CE) in Dye sensitized solar cells. The gold nanoparticles (AuNPs) bind to DNA in aqueous solution due to the polyanionic nature of DNA. When a scribe is made on the dropcasted Au-DNA solution, the diffusion of Au-DNA complex occurs towards the edges of the scribe due to the coffee ring effect. Capillary force induces evaporation of water that also forces the Au-DNA complex to migrate towards the scribed edges. Meanwhile, the AuNPs are reduced on the surface of DNA to form active seed for nucleation and growth of AuWs. DNA molecules act as a scaffold to arrange the nanoparticles into well-connected submicron to nanoscale wires. The cyclic voltammetry measurements showed that AuWs/Pt/ITO CE exhibited better electro-catalytic activity and higher conductivity than conventional Pt/ITO CE due to the synergistic effect of Pt and AuWs network on ITO. The DSSC fabricated using TiO<sub>2</sub> photoanode, N719 dye, I<sub>3</sub><sup>-</sup>/I<sup>-</sup> electrolyte and AuWs/Pt/ITO CE showed a 36% increase in efficiency as compared to the cells made under same parameters but using conventional (Pt/ITO) CE.

## 1 Introduction

Dye sensitized solar cells (DSSCs) have attracted much attention since their discovery by Gratzel and Regan owing to the easy handling and low cost fabrication [1]. A DSSC works by absorbing light and electrochemically producing electrons from the photons [2] and consists of a dye adsorbed on nanocrystalline TiO<sub>2</sub> based photoanode, a counter electrode (CE) and a redox couple [3]. Various studies have been conducted to improve the overall light conversion efficiency of DSSCs to the level of silicon based solar technology. For example, by doping metal and non-metals into TiO<sub>2</sub> semiconductor electrode [4, 5], increasing the porosity of photoanode [6], development of alternative electrolytes [3], using modified CEs [7], etc. A CE is one of the most significant components of a DSSC which performs two crucial functions in DSSCs; to conduct electrons from the external circuit and actuate the reduction of the redox couple. One of the two steps of electrochemical process at CE occurs at the electrode–electrolyte interface (redox reactions). Moreover, the mass and charge transfer occur through the electrode. Quick reduction of I<sub>3</sub><sup>-</sup> to I<sup>-</sup> is crucial for high performance of DSSCs [8]. A CE material must possess high

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