

## Fabrication of Polymer-coated and Platinum-deposited ZnO Nanoparticles via Simultaneous Photocatalytic Deposition.

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Zinc oxide (ZnO) photocatalyst has received significant attentions due to its better theoretical electron mobility and higher charge diffusion coefficient when compared to a well-established photocatalyst, titanium dioxide ( $\text{TiO}_2$ ).<sup>[1]</sup> Synthesizing ZnO composite to facilitate the electron conductivity is one of the most common ways to enhance the activity by suppressing charge recombination.<sup>[2-6]</sup> In the absence of electron and hole scavengers, the incorporation of metal nanoparticles and polymer layer are proposed to benefit the charge transport of a semiconductor. Thus in this study, zinc oxide is deposited with platinum metal nanoparticles and a layer of polymer. This fabrication involved simultaneous photocatalytic reduction of platinum cation and photooxidative polymerization of phenol which utilizes photogenerated electrons and holes of ZnO, respectively as elucidated in Figure 1.

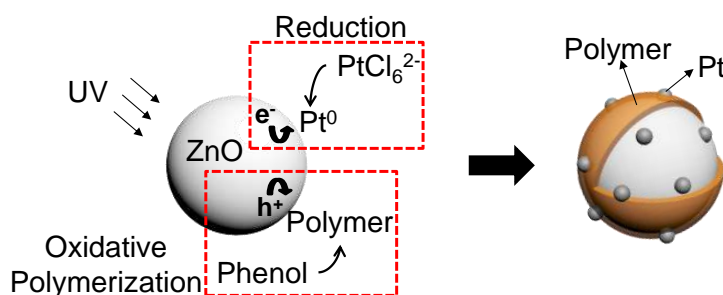


Figure 1: Schematic illustrating the simultaneous reduction and oxidation pathway for the photocatalytic synthesis of Poly/Pt/ZnO.<sup>[7]</sup>

By comparing the photoelectrochemical performances, the photocurrent density of Poly/Pt/ZnO appears to be higher than platinum deposited ZnO (Pt/ZnO) followed by bare ZnO. This enhancement is due to the presence of platinum that acts as an electron sink to suppress the electron-hole pair recombination. On top of that, further increment of photocurrent in Poly/Pt/ZnO reveals the effectiveness of polymer layer in enhancing the charge separation within ZnO. Even though platinum, an electron sink is known to have the capability in promoting electron transfer, Pt/ZnO was restricted by the transport of holes due to the slow consumption of holes by the electrolyte. Thereby, it is proposed that the polymer species coated on ZnO is beneficial in terms of hole withdrawal which was verified by measuring the photocurrent density in the presence of hole scavenger (5 v/v% ethanol). The photocurrent density of Pt/ZnO and Poly/Pt/ZnO appear to be similar in the presence of hole scavenger suggesting that ethanol (i.e. a strong reducing agent) consumes all the photoinduced holes and defeated the roles of polymer layers. The proposed scheme displaying

the charge transport of Poly/Pt/ZnO (i.e. electrons to platinum and holes to polymer layer) is illustrated in Figure 2. In conclusion, this study demonstrated the important roles of polymer layer on photocatalyst in facilitating hole transport resulting in an enhanced photoactivity.

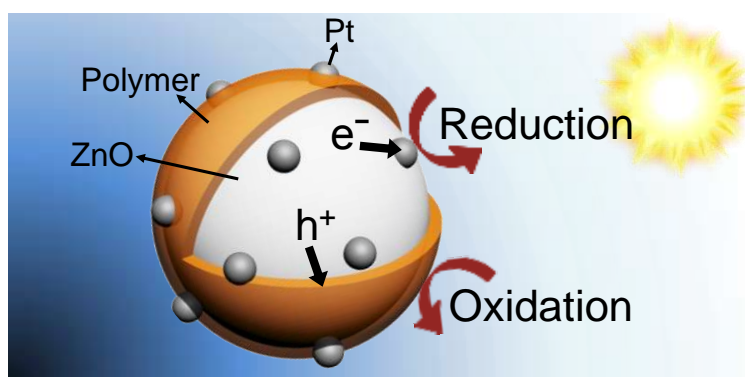


Figure 2: Schematic illustrating the charge transport of Poly/Pt/ZnO.<sup>[7]</sup>

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