Catalytic activity and stability-enhanced polyelectrolyte brush-grafted catalysts

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Three types of surface treatments, namely, polyethyleneimine (PEI) coating, short PEI (S-PEI) grafting, and long PEI (L-PEI) grafting, were performed on polydopamine (Pdop)-based catalysts to enhance their catalytic activity and stability. Brush-grafted catalysts were prepared by the stepwise synthesis of Au and short (or long) PEI brushes on Pdop particles (PdopP/Au/S- or L-PEI grafting). PEI-coated Pdop-based catalysts (PdopP/Au/PEI coating) were also prepared as non-brush-grafted catalysts. Among the surface-treated PdopP/Au catalysts, the brush-grafted catalysts (S-PEI and L-PEI grafting) exhibited excellent and stable catalytic performance because the brush grafting enabled the protection of the catalysts against harsh conditions, effective transfer of reactants to the catalysts, and confinement of reactants around the catalysts. The brush-grafted catalysts could also more effectively decompose larger dyes than the non-brush-grafted catalysts. The process-to-effectiveness of PEI coating is the best because the release of Pdop from PdopP/Au was moderately inhibited by the presence of only one layer of PEI coating on the PdopP/Au. Thus, this approach could be an alternative method to enhance the stability of PdopP/Au catalysts.

References

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Figures

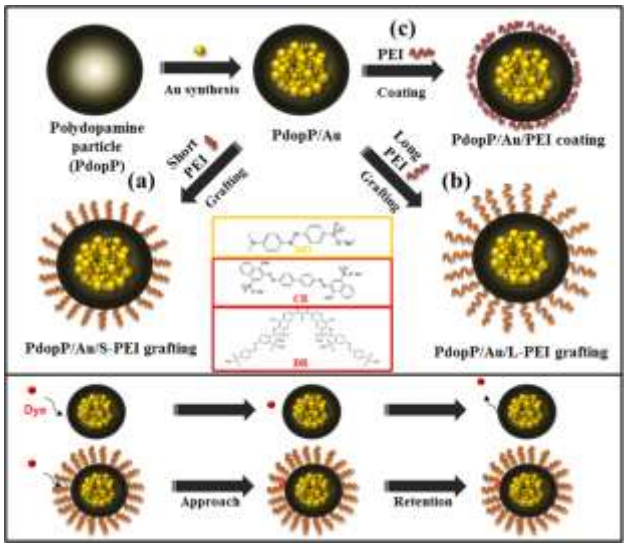

Figure 1. (Upper panel) Schematic illustration of the synthesis of three types of surface-treated PdopP/Au catalysts, including catalysts (a, b) with and (c) without brushes. Brush-grafted catalysts: (a) PdopP/Au/S-PEI grafting and (b) PdopP/Au/L-PEI grafting. Non-brush-grafted catalysts: (c) PdopP/Au/PEI coating. (Lower panel) Schematic illustration showing characteristics of brush-grafted catalysts. The PEI was selected as a PE brush because the PEI can be easily grafted onto the surface of PdopP by the grafting-to method using a Michael-addition reaction. Among the PEIs, branched PEI was used to maximize the content of amine groups of the brush chain.