Supplementary Material
E-factor calculations for the synthesis of 1 and 2 and the reported three other catalysts: Pt@hc; ARP-Pt; Pt-GLY.

Calculation of E-factor values for various Pt nanocatalyst systems:

\[ E\text{-factor} = \frac{K_g \text{(waste)}}{K_g \text{(product)}} \]

1. *Chem. Commun.*, 2008, 3181 (Pt@hc)

\[
\text{TiO}_2 + (500 \text{ mg}) + \text{OH} + (200 \text{ mg}) + \text{H}_2\text{PtCl}_6 \overset{\text{hv, vacuum}}{\rightarrow} \text{H}_2 + (\text{unreacted}) + \text{Pt @ polyphenol @ TiO}_2
\]

Carbonization at 973K

\[
\text{Nano Pt @ hC} \overset{\text{HF}}{\leftarrow} (5 \text{ cc}) (5.75 \text{ g}) \rightarrow \text{Nano Pt @ hC @ TiO}_2
\]

Total amount of reactants: 500 mg + 200 mg + 3.15 mg + 5.75 g = 6.48 g
Amount of final product: 203 mg., assuming that the same amount of phenol and platinum salt used in the beginning are retained in the final catalyst.
Amount of waste: (6.48 − 0.203) g = 6.277 g

\[ \text{E-Factor} = \frac{\text{Amount of waste}}{\text{Amount of product}} = 6.277/0.203 = 30.92 \]

\[
\text{NaOH} + \text{H}_2\text{PtCl}_6 \cdot 6 \text{H}_2\text{O} \rightarrow \text{Nano Pt in solution (in glycol)}
\]

\[
\text{PVP (1.288 g)} \rightarrow \text{PVP stabilized Nano Pt (Pt-GLY)}
\]

Total amount of reactants: 0.150 g + 16.65 g + 0.15 g + 1.288 g = 18.178 g
Amount of final product: 1.328 g, assuming that the same amount of PVP and platinum salt used in the beginning retain in the final catalyst.
Amount of waste: (18.178 – 1.328) g = 16.85 g

E-Factor = Amount of waste/Amount of product = 6.277/0.203 = 12.68

E-Factor for the synthesis of Zeises salt, K[PtCl$_3$(C$_2$H$_4$)]•H$_2$O:

\[
\begin{align*}
K_2PtCl_4 &+ C_2H_4 + HCl \text{ (in water)} \xrightarrow{\text{SnCl}_2 \ (40 \text{ mg})} K[PtCl_3(C_2H_4)] \cdot H_2O + KCl + C_2H_4 \text{ (unreacted)} \\
(4.5 \text{ g}) &+ (2 \text{ g}) + (8.21 \text{ g}) & \rightarrow & (3.86 \text{ g})
\end{align*}
\]

Total amount of reactants: 4.5 g + 2 g + 8.21 g = 14.71 g [solvent (water) and catalyst (SnCl$_2$) have been excluded from this calculation].

Amount of final product: 3.86 g

Amount of waste: (14.71 – 3.86) g = 10.85 g

E-Factor = Amount of waste/Amount of product = 10.85/3.86 = 2.81

E-Factor for the synthesis of final catalyst:

\[
\begin{align*}
\text{PS-PEG amino resin} &+ K[PtCl}_3(CH_2CH_2)] \rightarrow \text{ARP-Pt} \\
(3.2 \text{ g}) &+ (372 \text{ mg}) & \rightarrow & (3.4 \text{ g})
\end{align*}
\]

Total amount of reactants: 3.2 g + 0.372 g + 5.22 g = 8.792 g

Amount of final product: 3.4 g

Amount of waste: (8.792 – 3.4) g = 5.392 g

E-Factor = Amount of waste/Amount of product = 5.392/3.4 = 1.58

Total E factor = 2.81 + 1.58 = 4.39
4. Our systems:

For catalyst 1

\[ 15 \text{Na}_2\text{PtCl}_6 + 31 \text{NaOAc} + 31 \text{MeOH} + 30 \text{CO} \rightarrow \text{Na}_2[\text{Pt}_{15}(\text{CO})_{30}] + 31 \text{AcOH} + 31 \text{HCHO} + 31\text{HCl} + 59 \text{NaCl} \]

Total amount of reactants: 100 mg + 120 mg + 200 mg + 650 mg + 10 gm = 11070 mg.
Amount of final product: 800 mg
Amount of waste: (11070 – 800) mg = 10270 mg.
E-Factor = Amount of waste/Amount of product = 10270/800 = 12.8

For catalyst 2

\[ \text{Na}_2\text{PtCl}_6 + \text{Poly(DADMAC)} + \text{MeOH} \rightarrow [\text{PtCl}_6]^{2-}\text{@Poly(DADMAC)} + \text{H}_2 \]

Total amount of reactants: 100 mg + 650 mg + 10 g + 1 g = 11750 mg.
Amount of final product: 750 mg
Amount of waste: (11750 – 750) mg = 11000 mg.
E-Factor = Amount of waste/Amount of product = 11000/750 = 14.66