

## Supporting information

# Particle shape optimization by changing from isotropic to anisotropic nanostructure:

## Preparation of highly active and stable supported Pt catalysts in microemulsions

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### 1. Activity testing in hydrogenation reaction.

To ensure the accuracy of activity testing, all catalysts were kept away from contact with air. We tested the catalysts in the hydrogenation of  $\alpha$ -methyl styrene (AMS) at 20 °C and 1.1 bar. The hydrogenations were performed in a 200 ml double-walled glass reactor equipped with glass baffles and a gas-dispersion stirrer. The scheme of the hydrogenation reactor set-up is presented in Fig. S1. Hydrogen and nitrogen gas lines were attached to the reactor. A vacuum pump was attached to evacuate the reactor. The reactor system was connected to a pressure controller (to keep the pressure constant) and a flow meter (to measure the hydrogen required to replace the amount of hydrogen consumed by the reaction). Both were connected to a computer with a control program.

The supported platinum catalyst was added to the reactor, subsequently with adding 100 ml methanol as solvent and 1 g AMS, respectively. The reactor was closed and sealed followed by the reduction of pressure down to 0.2 bar (and holding it for 5 minutes in order to check for a gas leakage). Having ensured that there was no leakage, the mixture was stirred at 600 rpm and 20 °C for 20 minutes. The reactor was evacuated three times, by reducing the pressure to 180 mbar, and then refilled with nitrogen. Afterward the reactor was evacuated to

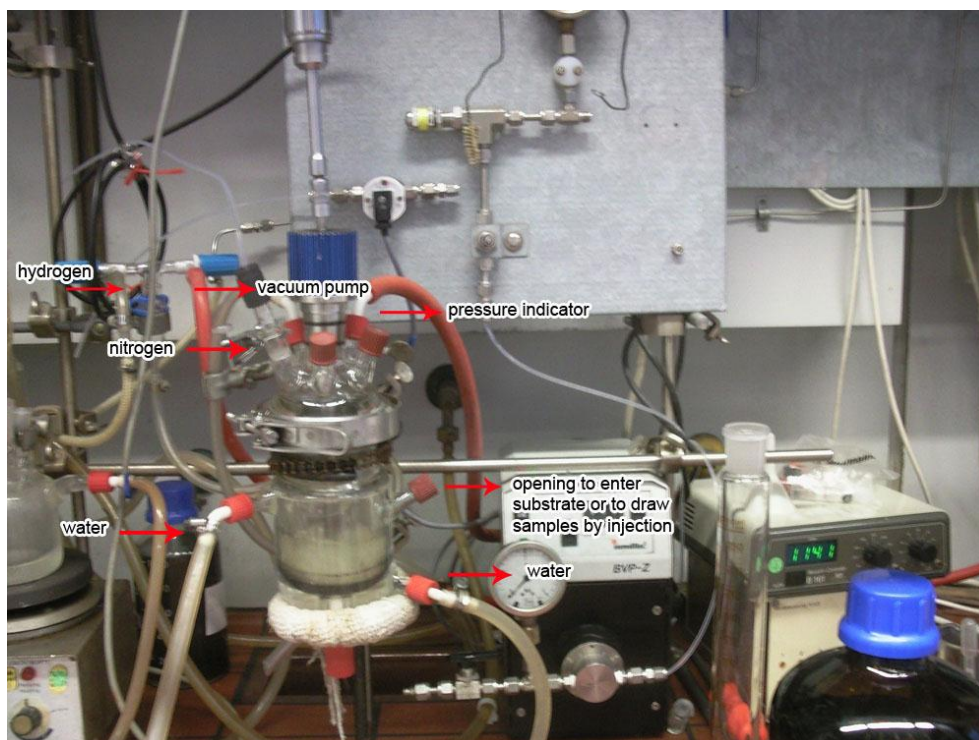
180 mbar and filled with hydrogen until it reached a total pressure of 1.1 bar. The computer program was started along with the stirring up the mixture at 1200 rpm. The reaction was stopped when the data acquisition indicated that there was no further hydrogen consumed in the reaction. A representative reaction profile is presented in the Fig. S2.

Based on the fact that one molecule hydrogen is needed per one double bond of AMS ( $n_{\text{product}} = n_{\text{H}_2}$ ), the moles of product can be calculated by the moles of consumed hydrogen. The rate of product formation is calculated from eq. (1), based on the ideal gas law, using the rate of hydrogen consumption which was measured by the flow meter.

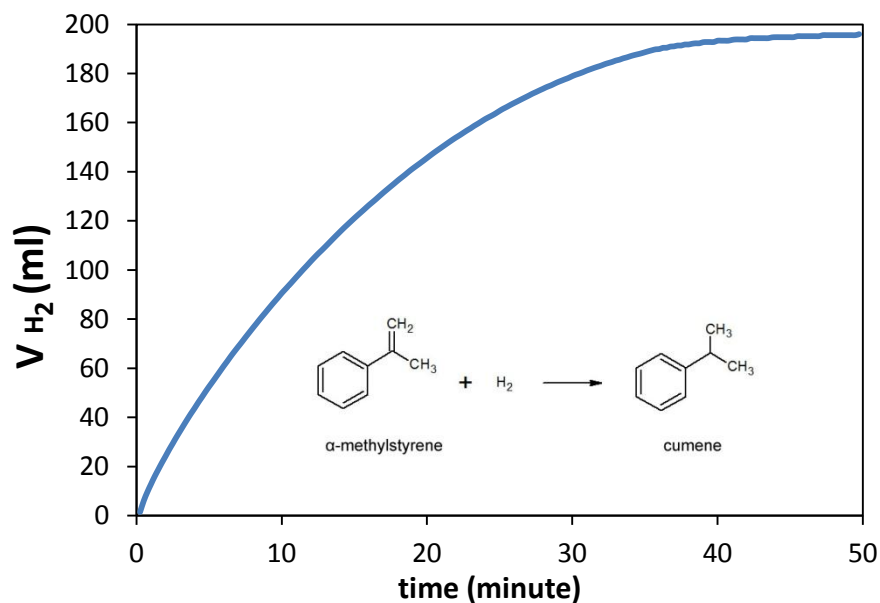
$$\frac{dn_{\text{product}}}{dt} = \frac{P}{RT} \frac{dV(\text{H}_2)}{dt} \quad (1)$$

By dividing the value of  $dn_{\text{product}}/dt$  by amount of Pt metal on the support (analyzed by ICP), we get the value of activity (eq.(2)).

$$\text{Activity}(\mu\text{mol} \cdot \text{g}_{\text{Pt}}^{-1} \cdot \text{s}^{-1}) = \frac{dn_{\text{product}}}{dt \cdot m_{\text{Pt}}} \quad (2)$$



**Fig. S1** Hydrogenation setup



**Fig. S2** A representative profile of AMS hydrogenation with 0.01 wt.% Pt/Al<sub>2</sub>O<sub>3</sub> at 20°C and 1 bar

## 2. Calculation of Pt dispersion

The dispersion of Pt on Al<sub>2</sub>O<sub>3</sub> was calculated according to D. J. Bray et al.<sup>1</sup> A section of the TEM picture was selected and within this section the Pt particles were marked. The area of marked Pt particles ( $\sum a_i$ ) was calculated and divided by the area of the section ( $A_{\text{section}}$ ) to obtain  $A_f$ , the area fraction covered by the nanoparticles. Then, a Pt nanoparticle was selected and connected to the next two Pt nanoparticles near-by to obtain a triangle. This procedure was repeated until all Pt nanoparticles were connected by triangles and the Delaunay network was obtained. The arrangement of the Pt particles within this network is expressed by  $A_D$ , the area disorder value.  $A_D$  was calculated from Eq. (1).

$$\overline{AD}_{Del} = 1 - \frac{1}{\left(1 + \frac{s_A}{\overline{A}}\right)} \quad \text{Eq. (1)}$$

In Eq. (1),  $\overline{A}$  is the mean area of the triangles and  $s_A$  is the standard deviation. At least  $A_f$  and  $\overline{AD}_{Del}$  were used to obtain the quality of dispersion from the classification diagram (Fig. S3).

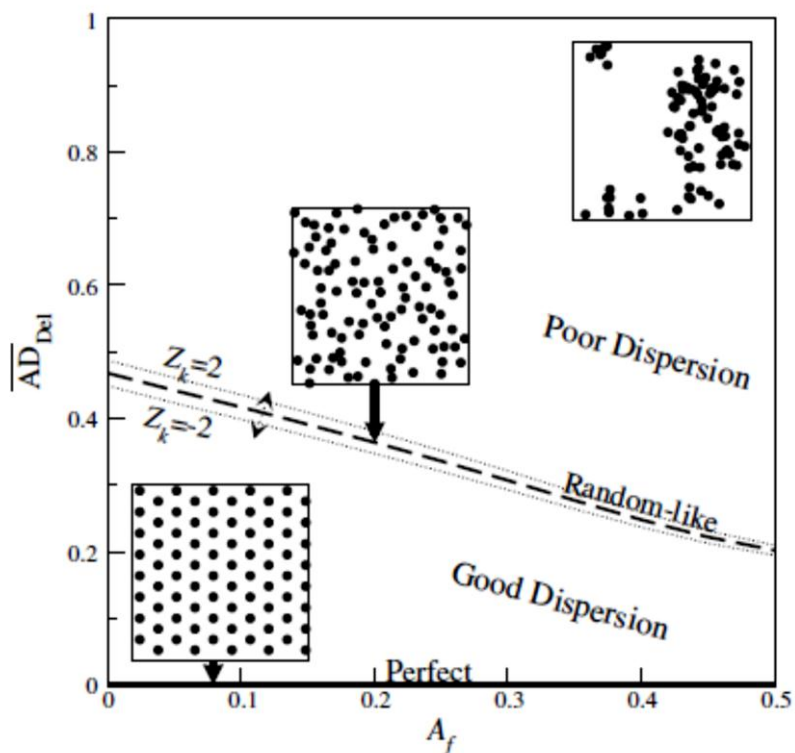


Fig. S3 Classification diagram of dispersion for given combinations of Area Disorder and area fraction (reproduced from Figure 2 in Ref.1).

### Reference

1. D. J. Bray, S. G. Gilmour, F. J. Guild, T. H. Hsieh, K. Masania, and A. C. Taylor, *Journal of Materials Science*, 2011, **46**, 6437–6452.