

S2 Calculation of dispersion

Based on the TPR analysis of the samples, it can be found that at 380 °C, the conversion of $\text{Mn}^{4+} \rightleftharpoons \text{Mn}^{3+}$ ($\text{Mn}_2\text{O}_3 + \frac{1}{2}\text{O}_2 \rightarrow 2\text{MnO}_2$) occurred in the catalyst during the oxidation. Therefore, the formula for calculating dispersion is as follows:

$$D = \frac{n_{\text{Mn}}^* \times M_{\text{Mn}}}{W_{\text{Mn}}} = \frac{n_{\text{O}_2} \times M_{\text{Mn}}}{4W_{\text{Mn}}}$$

Where D , n_{Mn}^* , M_{Mn} , W_{Mn} , and n_{O_2} are the dispersion of Mn on the surface of catalysts, effective Mn content of unit mass catalyst ($\text{mol} \cdot \text{g}^{-1}$), relative atomic mass of Mn and percentage of Mn element in catalysts, oxygen-consumption per unit mass of catalyst ($\text{mol} \cdot \text{g}^{-1}$), respectively.