Aerobic Oxidation of Alcohols with MoS$_2$/Ta$_3$N$_5$ Nanocomposites

Significance: Ta$_3$N$_5$ nanoparticles partly coated with a MoS$_2$ layer (MoS$_2$/Ta$_3$N$_5$ NPs) were prepared by hydrothermal treatment of Ta$_3$N$_5$ NPs with (NH$_4$)$_6$Mo$_7$O$_24$ in the presence of thiourea (eq. 1). MoS$_2$/Ta$_3$N$_5$ NPs catalyzed the aerobic oxidation of alcohols under oxygen (1 atm) to give the corresponding aldehydes or ketones in up to 99% conversion with 99% selectivity (13 examples, eq. 2).

Comment: MoS$_2$/Ta$_3$N$_5$ NPs were characterized by SEM, TEM, XRD, ICP-AES and elemental analysis. The catalyst also promoted the aerobic oxidation of amines, sulfides, and alkenes to afford the corresponding imines, sulfoxides, and epoxides (eq. 3). In the oxidation of benzyl alcohol, the catalytic activity of MoS$_2$/Ta$_3$N$_5$ NPs was superior to that of Ta$_3$N$_5$ NPs and MoS$_2$.

**Equations:**

1. Ta$_3$N$_5$ NPs $\xrightarrow{(NH_4)_6Mo_7O_{24}, H_2N\_NH_2, H_2O, 180 \degree C, 20 h} \text{MoS}_2/Ta_3N_5$ NPs (5 wt% MoS$_2$)

2. $\text{R}_1\text{R}_2\text{OH}$ $\xrightarrow{\text{MoS}_2/Ta_3N_5 \text{ NPs} (40 \text{ mg})}$ $\text{R}_1\text{R}_2\text{O}$

3. $\text{N,N-dimethylacetamide}$ $\xrightarrow{120 \degree \text{ C}, \text{O}_2 (1 \text{ atm})}$

**Selected results:**

- For alcohols:
  - 1.5 h, 85% conversion, 99% selectivity
  - 3.0 h, 66% conversion, 99% selectivity
  - 1.5 h, 99% conversion, 99% selectivity
  - 3.0 h, 78% conversion, 99% selectivity
  - 4.0 h, 80% conversion, 99% selectivity

- For amines, sulfides, and alkenes:
  - 1 mmol NH$_2$ $\xrightarrow{\text{MoS}_2/Ta_3N_5 \text{ NPs} (40 \text{ mg})}$ 3.0 h, 52% conversion, 99% selectivity
  - 1 mmol SMe $\xrightarrow{\text{MoS}_2/Ta_3N_5 \text{ NPs} (40 \text{ mg})}$ 3.0 h, 50% conversion, 99% selectivity
  - 1 mmol $\xrightarrow{\text{N,N-dimethylacetamide}}$ 6.0 h, 49% conversion, 94% selectivity