

Supporting information

1. SEM analysis

Catalyst powder surface morphology can be observed via a field-emission scanning electron microscope. The morphology of $S_2O_8^{2-}/ZrO_2-TiO_2-SiO_2$ composite is shown in the SEM image, where numerous lamellar crystals can be observed in Figure 1S. The EDS pattern shown in Figure 2S, indicates that the $S_2O_8^{2-}/ZrO_2-TiO_2-SiO_2$ catalyst contained Si, Zr, Ti, O, S. The Cu peak was attributable to the Cu plate that the samples were dispersed on, and Au was introduced during the EDS analysis process.

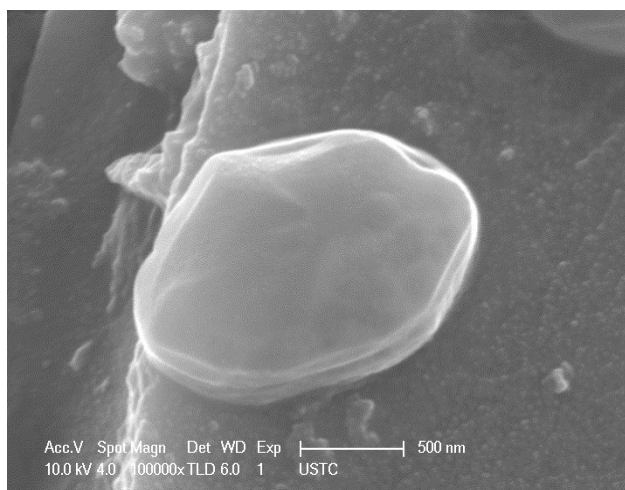


Figure 1S SEM images of $S_2O_8^{2-}/ZrO_2-TiO_2-SiO_2$ composites

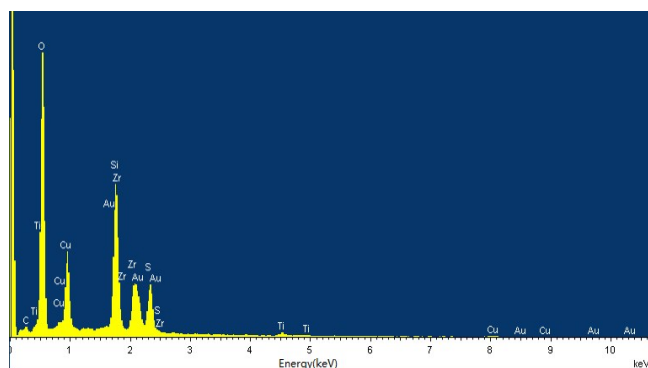


Figure 2S EDS images of $S_2O_8^{2-}/ZrO_2-TiO_2-SiO_2$ composites