Nanoparticles of MoS$_2$ and WS$_2$ were synthesized by decomposing the appropriate metal hexacarbonyl in the presence of sulfur dissolved in decalin at 140°C. A significant fraction of the nanoparticles was $\leq 15$ nm in diameter as verified by Transmission Electron Microscopy. The process was repeated in the presence of silica and then titania to produce supported metal sulfides. The unsupported nanoparticles were found to exhibit a size-dependent shift in their threshold UV-visible absorption due to quantum confinement. Photocatalytic properties of each sulfide from synthesis in decalin were explored by using each as a catalyst in the photodegradation of methylene blue by visible light. These sulfides were also used to catalyze the photodegradation of acetone.

Unsupported MoS$_2$ and WS$_2$ nanoparticles catalyzed the photodegradation of acetone under visible light of $\geq 400$ nm wavelength. This is the first study reporting the photocatalytic properties of the unsupported WS$_2$ nanoparticles. Photodegradation of methylene blue under $\geq 435$ nm irradiation was detected using unsupported WS$_2$ but not unsupported MoS$_2$, likely because activity was masked by the likely photobleaching of the dye. When deposited on silica or titania, the nanosized MoS$_2$ and WS$_2$ could be...
uniformly distributed in aqueous solutions to maximize the photocatalytic efficiency. Correcting the absorbance measurements for light scattering by solids proved to be beneficial for extracting kinetic information. Both silica deposited sulfides were found to significantly increase the rate of methylene blue photodegradation, and deposited WS2 increased this rate significantly more than deposited MoS2. Similarly, both titania deposited sulfides significantly increased the rate of methylene blue photodegradation, and the deposited WS2 increased this rate significantly more than the deposited MoS2.