MoO_3-Embedded Polymer Sensors for Narrowband UV Rejection in Optical and Fiber Configurations

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Abstract

A laser-induced synthesis route was employed to fabricate molybdenum trioxide (MoO_3) crystals by irradiating molybdenum disulfide (MoS_2) with a high-power blue laser. This photonic process provided sufficient energy to initiate the replacement of sulfur atoms with oxygen, effectively converting MoS_2 into MoO_3. Comprehensive structural and morphological characterizations confirmed the successful oxidation and crystalline integrity of the final product. To explore their optical utility, the synthesized MoO_3 crystals were incorporated into a polymer matrix to develop ultraviolet (UV) rejection filters with targeted selectivity in the 200–220 nm range. Two distinct sensor formats were investigated: flat disc-type sensors and optical fiber-integrated configurations. These were fabricated using different MoO_3 loadings (0.5 wt%, 1 wt%, and 2 wt%) to evaluate spectral filtering performance under both transmission and absorption conditions. Additionally, the influence of fiber length (1 cm, 2 cm, and 3 cm) on spectral response was systematically examined. The results revealed that the MoO_3-based composites exhibit strong and tunable UV-blocking capabilities, with performance dependent on concentration, geometry, and optical path length. These features highlight the material's potential in applications such as UV detection, wearable photoprotection, and wavelength-selective optical systems requiring precise control in the deep UV region.

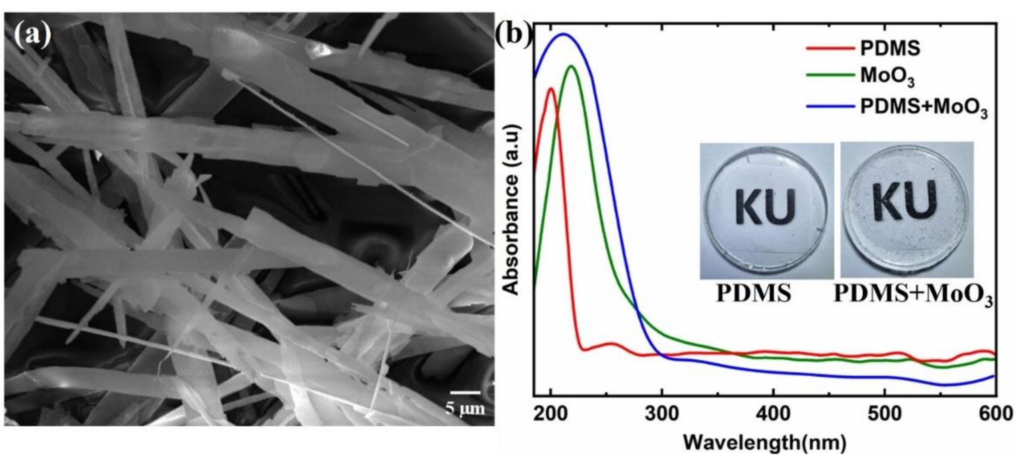

Figure 1. (a) SEM of Laser assisted synthesized MoO_3 crystals. (b) Absorption spectra of Polymer (PDMS), MoO_3 crystals and MoO_3 based polymer composite for selective UV-filtering from 200-220 nm. Transparency of the filter can be seen in the inset pictures.