ABSTRACT

Titanium dioxide (TiO_2) is a widely used semiconductor material for photocatalytic applications due to its high chemical stability, non-toxicity, and low cost. However, its photocatalytic performance remains limited by its wide band gap and the rapid recombination of photogenerated electron-hole pairs. To enhance its performance, TiO_2 was modified with copper and zinc dopants. This study aims to synthesize TiO_2 and CuZn-doped TiO_2 (TiO_2:CuZn) nanoparticles using the pulsed laser ablation in liquid (PLAL) method, and to evaluate their photocatalytic properties in the degradation of methylene blue. The synthesis was carried out by ablating a Ti target using a 1064 nm Nd:YAG laser for 30 minutes, followed by CuZn alloy ablation for 3, 6, 9, 12, and 15 minutes. X-ray diffraction analysis confirmed that the anatase crystal structure was preserved after CuZn modification. UV-Vis spectroscopy showed a red-shift in absorption and a reduction in the optical band gap from 3.9 eV (pure TiO_2) to 3.36 eV in the 9-minute CuZn modified sample. TEM images revealed spherical nanoparticles with nanometer size range, while FTIR spectra indicated no significant changes in the main Ti-O functional groups. Photocatalytic degradation tests of methylene blue showed that TiO_2:CuZn with a 9-minute ablation time achieved the highest degradation efficiency of 93% compared to 41% for pure TiO_2. This enhancement is attributed to the reduced band gap and suppressed charge carrier recombination. These results indicate that TiO_2:CuZn synthesized via the PLAL method holds strong potential as a photocatalytic material for organic pollutant degradation.

Keywords: *Titanium dioxide, CuZn, pulsed laser ablation, photocatalyst, methylene blue.*