Supporting Information

Combinatorial effects of non-thermal plasma oxidation processes and photocatalytic activity on the inactivation of bacteria and degradation of toxic compounds in wastewater

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S1. Materials and Methods

Photoluminescence (PL) spectra of the nanoparticles (NPs) were recorded using a spectrofluorometer (FP8300, JASCO, Japan). The optical properties of TiO_2 and Cu-TiO_2 were examined by ultraviolet-visible diffuse reflection spectroscopy (UV-Vis DRS) using a UV-Visible NIR spectrophotometer (V-770, JASCO, Japan).

S2. Results and Discussion

S2.1. UV-Vis DRS spectral analysis

Figure-S1a shows the UV-Vis absorbance spectra of the synthesized pure TiO_2 and Cu-TiO_2 NPs. The pure TiO_2 displayed an absorbance peak at approximately 365 nm representing a typical bandgap energy of 3.08 eV [1-3]. Doping TiO_2 NPs with Cu generally causes a narrowing band gap, which reduces the rate of electron-hole recombination resulting in a red shift [4]. Contradictorily, in our case, a shift in the absorbance peak towards lower wavelength of approximately 295 nm (blue shift) was observed. This blue shift might be due to the quantum size effect [4]. Moreover, the increment in particle size of Cu-TiO_2 probably caused a decrement in the absorbance spectrum wavelength (blue shift) [5]. In the absorbance spectrum, the intensity of the absorbance maxima (relative maxima) increased. The addition of metal (i.e. Cu in our case) probably initiated this hyperchromic shift in the absorbance maxima intensity. The DRS peaks of pure TiO_2 and Cu-TiO_2 were observed at 3.08 and 2.88 eV respectively. This is due to the oxygen vacancies and the sub-band states of the Cu dopant [6] (**Figure-S1b**). Hence, the observed bandgap decreased in the Cu-doped TiO_2 NPs. The obtained results also support the hypothesis of the particle size – band gap relation (the band gap decreased when the particle size increased).

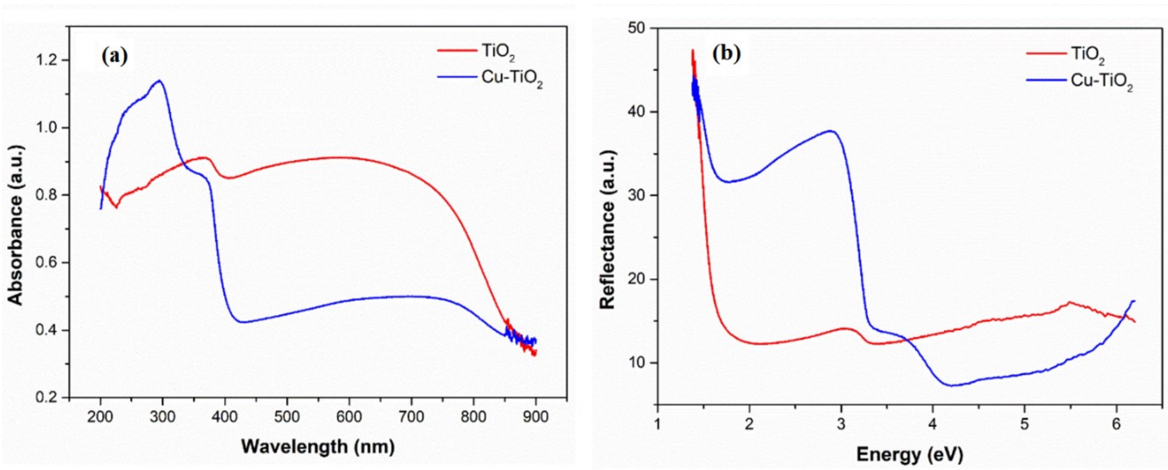

Figure- S1 (a) UV-Vis spectra and (b) diffuse reflection spectra of TiO_2 and Cu-TiO_2 NPs

S2.2. Photoluminescence emission spectral analysis

Figure-S2, depicting the PL spectra of pure TiO_2 and Cu-TiO_2 NPs, shows that the emission intensity of the Cu-TiO_2 NPs is slightly higher than the pure TiO_2 NPs without any shifts in the emission wavelength. Since the size of the Cu-TiO_2 NPs is larger than the pure ones, the surface-to-volume ratio was also decreased. This increased the oxygen defects and vacancies, which further up surged the photoluminescence intensity thus enhancing the photocatalytic activity of the Cu-TiO_2 NPs [7].

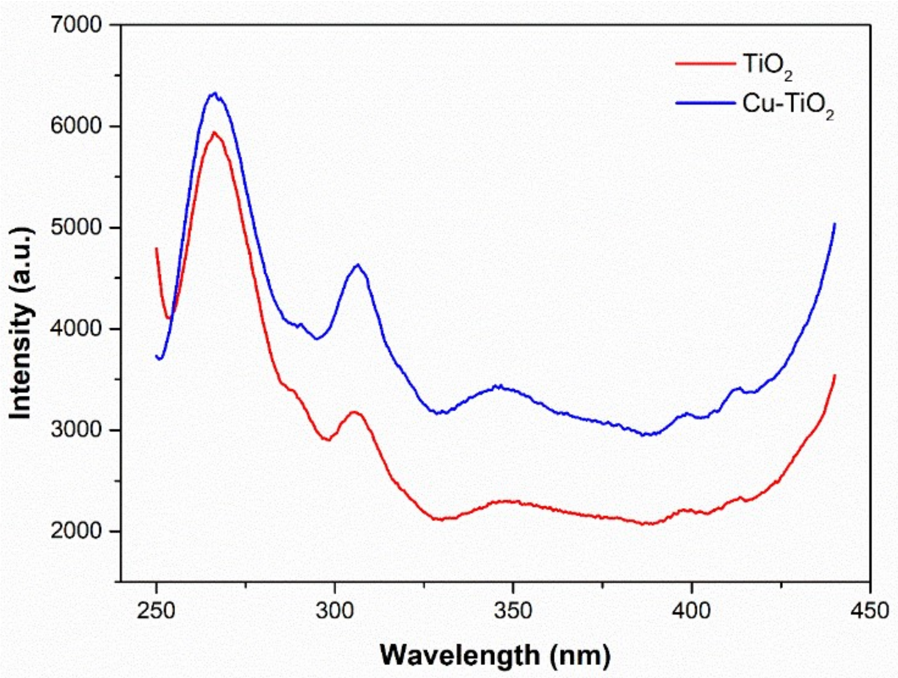

Figure-S2 Photoluminescence (PL) spectra of TiO_2 and Cu-TiO_2 NPs

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