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Title: Significantly Enhanced Visible Light Photocatalytic Efficiency of Phosphorus doped TiO<sub>2</sub> with surface oxygen vacancies for Ciprofloxacin Degradation: Synergistic Effect and Intermediates Analysis

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**Significantly Enhanced Visible Light Photocatalytic Efficiency of Phosphorus  
doped TiO<sub>2</sub> with surface oxygen vacancies for Ciprofloxacin Degradation:  
Synergistic Effect and Intermediates Analysis**

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**Highlights:**

- Simultaneous P-doping and Oxygen Vacancies creation on anatase TiO<sub>2</sub>
- The synergy of P-doping and oxygen vacancies promoted the visible absorption
- Significant enhancement on the photocatalytic activity under visible light irradiation
- Synergistic effect promotes the photo-generated carriers separation and transmission

**ABSTRACT**

In the present work, we reported a simple method for the simultaneous phosphorus (P) doping and oxygen vacancies creation on TiO<sub>2</sub> in a single step. The obtained P-doped TiO<sub>2</sub> with surface oxygen vacancies (PTSOV) samples exhibited efficient photocatalytic activity for the degradation of fluoroquinolone antibacterial agent (ciprofloxacin) under visible light irradiation. The optimized sample showed a rate constant of 0.065 min<sup>-1</sup> for degradation of ciprofloxacin (CIP) and it was about

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