
*The 6th International Conference on*

# New Photocatalytic Materials for Environment, Energy and Sustainability


*The 7th International Conference on*

# Photocatalytic and Advanced Oxidation Technologies for the Treatment of Water, Air, Soil and Surfaces

## ABSTRACTS

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# Impact of water matrices and inorganic ions on the removal of organic pollutants by $TiO_2$/LED and ZnO/LED heterogeneous photocatalysis using 365 nm and 398 nm irradiation – radical formation, reaction mechanism, mineralization, and efficiency

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In this work, the application of high-power $LED_{365nm}$ and commercial, low-cost $LED_{398nm}$ for heterogeneous photocatalysis with $TiO_2$ and ZnO photocatalysts is studied and compared. Coumarin (COU) and its hydroxylated product (7HC) were used to investigate operating parameters and the impact of matrices and matrix components, such as $Cl^-$ and $HCO_3^-$ on the removal efficiency, mineralization, and formation of hydroxyl radical. The transformation of COU was slower for $LED_{398nm}$ than for $LED_{365nm}$, but $r_0^{7HC}/r_0^{COU}$ ratio was significantly higher for $LED_{398nm}$ while using 1,4-benzoquinone, the more enhanced charge separation was observed for ZnO than $TiO_2$, especially at 398 nm irradiation. The contribution of the direct charge transfer was found more significant for ZnO than for $TiO_2$; however, the mineralization rate of COU was the same. The impact of biologically treated domestic wastewater, $Cl^-$ and $HCO_3^-$, as the main inorganic components of the matrix, was found to be significantly different for ZnO and $TiO_2$. The negative effect of $HCO_3^-$ was evident for both catalysts; however, for $TiO_2$, the formation of $CO_3^{\bullet-}$ almost doubled the 7HC formation rate.

Transformation of N-containing organic substances, such as imidacloprid, thiacloprid, sulfamethazine and sulfamethoxypyridazine were also studied and compared. Based on the effect of inorganic ions on conversion rates and distribution of intermediates, it is likely that the $CO_3^{\bullet-}$ formed on $TiO_2$ contributes to the conversion. $TiO_2$ was much more sensitive to both matrices and inorganic ions than ZnO, but effect depended strongly on the organic susbtsnaces. The results reflected that, the matrix effect cannot be interpreted solely by the radical scavenging effect of the inorganic ions and organic components, even in the case of relatively mild matrices.

An extremely fast transformation and high quantum yield of sulfamethoxypyridazine in the $TiO_2/LED_{398nm}$ process were observed. The transformation was fast in both $O_2$ containing and $O_2$-free suspensions and takes place via desulfonation, while in other cases, mainly hydroxylated products form. The effect of reaction parameters (methanol, dissolved $O_2$ content, presence of $HCO_3^-$ and $Cl^-$) confirmed that a quite rarely observed direct energy transfer between the excited state P25 and sulfamethoxypyridazine is likely responsible for this unique behavior; however, the role of direct charge transfer cannot be excluded completely.

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