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Introduction

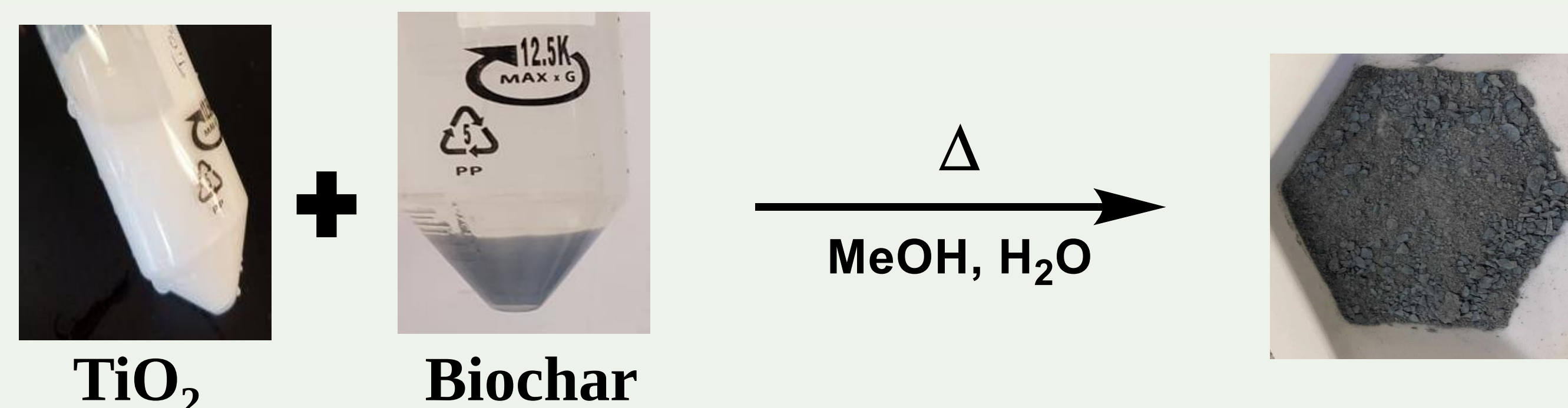
Tackling water pollutants is one of the top priorities, which poses a potential threat to water consumers. Among different pollutant, organic material, especially dyes, are one the most resistance pollutant that needs specialized technique to remove¹. Photodegradation is one the most effective techniques for this purpose which uses the free and easy access of solar light to degrade organic pollutants. TiO₂ is the most promising and established photocatalyst that has been of interest to many researchers². However, its limitation, especially its wide bandgap, is a significant obstacle that limits its application. Much research has thus been done to overcome these limitations and making composites of TiO₂ with carbon-based materials (CBM) has emerged as a promising way to enhance the semiconductor's photocatalytic activity. Biochar, the CBM produced through pyrolyzing organic waste, has been of particular interest for use in such composites due to its low price, sustainability, and properties, including porosity, large surface area, and the diversity of its possible surface functional groups³.

Methods

Synthesis: Biochar/TiO₂ Nanocomposites prepared via facile reflux method using different percentages of each component. In detail, the desired amount of Biochar, *e.g.*, 50, 100,200 and 300 mg (for the synthesis of the composite of 5, 10, 20, and 30% Biochar/ TiO₂, respectively) of Biochar was added to methanol sonicated for 30 mins. The solvent was then added to a pre-sonicated aqueous solution of TiO₂. The final mixture then refluxed for 3 hours at 75 °C. The obtained powder was centrifuged and dried overnight at 60 °C.

Characterization: UV-Vis spectroscopy, IR spectroscopy, TEM, and Zeta potential surface area were used to characterize the composites.

Photocatalytic activity test: Photocatalytic activity of the synthesized materials was evaluated via degradation of Methylene Blue (MB, 20 ppm) under UV and Vis light irradiation.



Result and discussion

Primary characterization of the synthesis materials via FTIR, UV-Vis and TEM images indicate the successful synthesis of the composite materials. However, the light absorbance property of the composite did not change that much compared to the pristine TiO₂. This would be analysis via UV-DRS in order to have more accurate signals.

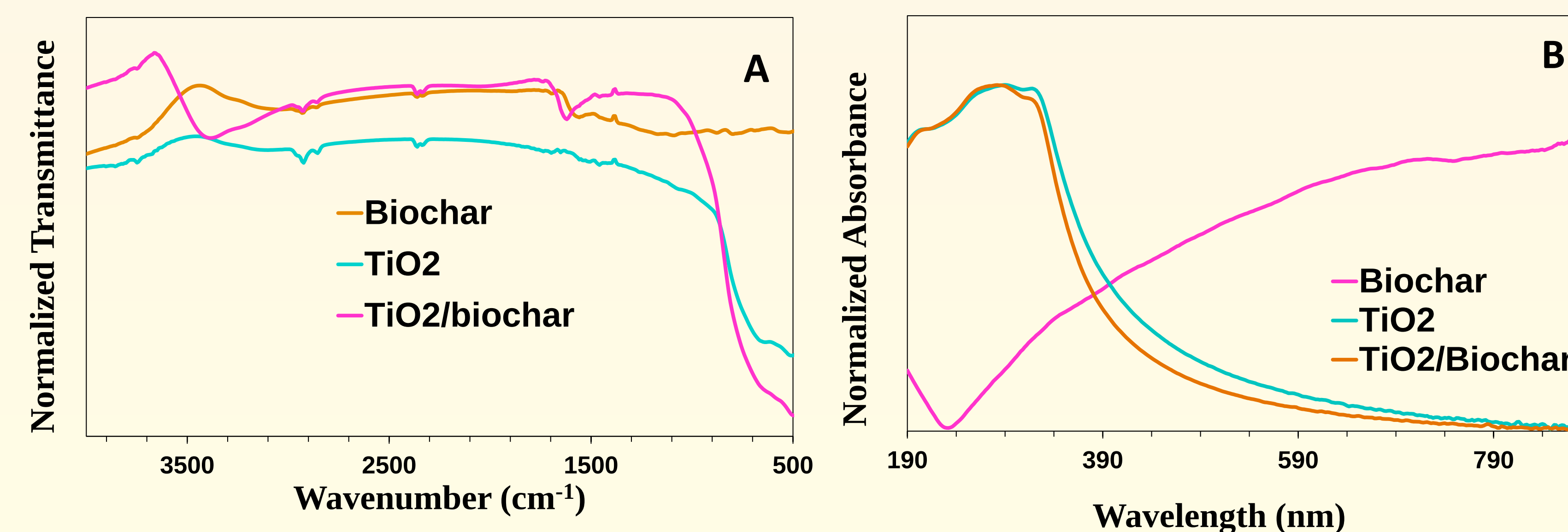


Fig. 1. A) FTIR and B) UV-Vis spectrum of the 10%Biochar/TiO₂ along with its precursors

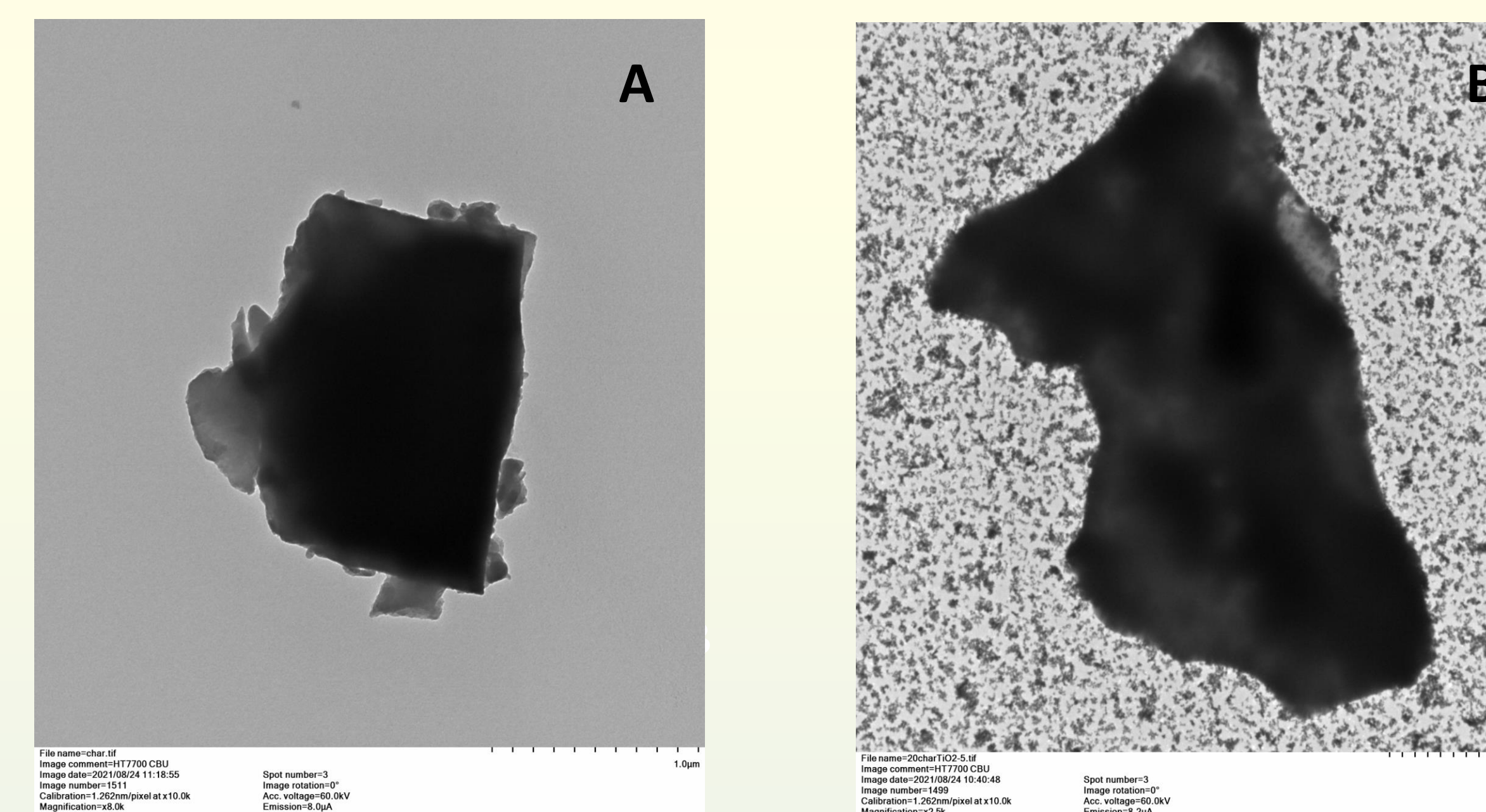


Fig. 2. TEM image of (A) Pristine Biochar and (B) synthesized 10% Biochar/ TiO₂.

Measuring the surface charge of the synthesized composites and their changes via changing the percentages from 32 mV for the pristine TiO₂ to the -10 mV for the 30% composite material, while it is -48 for the pristine char, could be another indicator of successful synthesis. It can also influence the dye adsorption on the surface of the composite, which leads to better degradation.

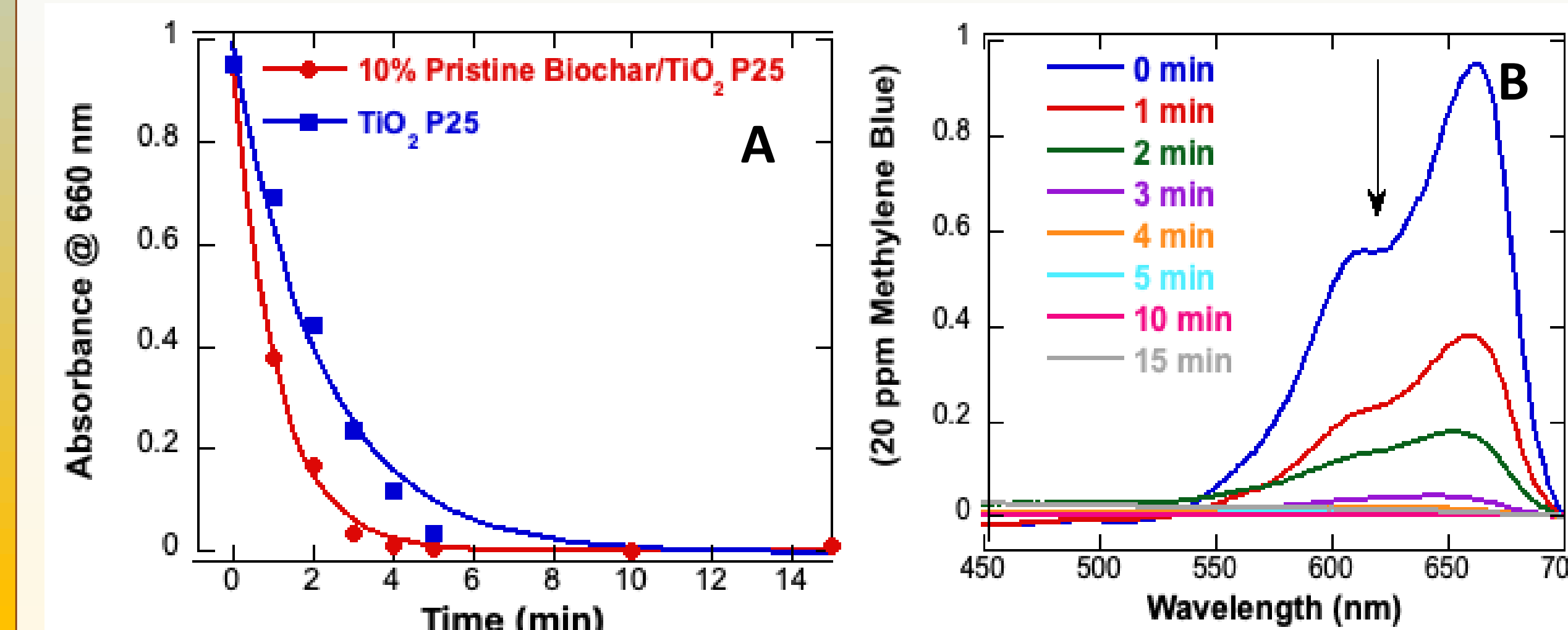


Fig. 3. A) Degradation efficiency and B) UV-Vis spectrum MB degraded by 10%Biochar/ TiO₂

The immediate result of MB degradation via the 10%Biochar/TiO₂ indicates a significant enhancement in the photocatalytic activity of the composite material compared to the pristine TiO₂. This can be due to the photogenerated electron/hole lifetime's increment due to the high conductivity of the Biochar.

Future works

As the initial data demonstrated some promising results, in the next step we have planned to do the photocatalytic study on the all of the synthesized material in order to find the optimized composition. In addition, more characterization such as XPS, XRD, BET needs to be done to have a deep understanding of the mechanism and ROS identification.

References

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- 3 M. J. Sampaio, C. G. Silva, A. M. T. Silva, L. M. Pastrana-Martínez, C. Han, S. Morales-Torres, J. L. Figueiredo, D. D. Dionysiou and J. L. Faria, *Appl. Catal. B Environ.*, 2015, 170–171, 74–82.