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Abstract of the PhD thesis

"Synthesis, characterization and photocatalytic properties of composite materials: TiO_2/carbon materials derived from biomass"

This PhD thesis presents a synthesis of new inorganic-organic composite materials based on TiO_2 and new carbon-based supports (e.g. Starbon®, biochar), by a conventional sol-gel and wet impregnation method promoted through unconventional sources of energy (ultrasound) and new composite materials prepared by laboratory batch pyrolysis system. Carbon supports proffer an extensive range of possibilities for heterogeneous photocatalysis due to a large specific surface area, high porosity and easily accessible functionality of the surface, which gives ample opportunity for chemical modification. The simple thermal treatment makes possible to functionalise inorganic-organic composite materials with promising physicochemical properties. Carbon materials derived from biomass have very interesting properties, owing to the presence of various functional groups on its surface, which depend on its pre-treatment (e.g. treatment with ultrasounds) and can potentially react in different ways with a precursor of TiO_2, leading to composite materials, which have different physicochemical properties. The use of ultrasonic radiation at the time of manufacture of such composite materials should improve the mass transfer, create (thanks to acoustic cavitation) a specific reactive environment and facilitate the migration of the TiO_2 precursor into the pores of the support. Additionally, modulation parameters of preparation may allow to investigate more carefully this process and to determine its optimal conditions in the preparation of highly efficient photo-active materials. The research plan for this PhD thesis focuses primarily on using cost-efficient methods such as ultrasound-assisted wet impregnation method, ultrasound-assisted sol-gel method, and laboratory batch pyrolysis system to study the synthesis, extensive characterization (e.g. XRD, BET, SEM, HR-XPS, FT-IR and DR UV–vis), and photocatalytic performance of prepared TiO_2/carbon materials derived from biomass by photocatalytic degradation of phenol (liquid phase) and selective oxidation of methanol (gas phase) in the self–constructed continuous fixed-bed photoreactor gas system which was built to correlate the photocatalytic properties of prepared materials under near UV and visible light irradiation.