Invitation à la soutenance publique de thèse de
Monsieur Franck William BOYOM TATCHEMA
Master en chimie

Pour l’obtention du grade de Docteur en sciences agronomiques et ingénierie biologique

«Synthesis of manganese dioxides (MnO₂) by gliding arc plasma route. Application to the catalytic degradation of Tartrazin Yellow in wastewaters»

qui se déroulera
le jeudi 20 décembre 2018 à 14h
Auditoire Doyen 21
Place des Doyens
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In the recent years, a great interest in fundamental and applicative research was focused on the synthesis and the utilization of metal oxides nanoparticles. The synthesis of organized mesoporous materials with a transition-metal oxide framework has stimulated many researches over the past decade, in order to improve their industrial applications. Among them, MnO₂ is one of the most attractive inorganic materials not only because of its physical and chemical properties and wide range of applications, but also because of its low cost and environmentally benign nature.

The present thesis work aims at preparing mesoporous MnO₂ nanomaterials with high activity and stability, through a gliding arc plasma route, for catalytic, photocatalytic and plasmacatalytic oxidation of Tartrazin Yellow as organic pollutant. The first part consists in highlighting the redox properties of gliding arc plasma for the synthesis of MnO₂ nanomaterials for catalytic purposes. Polymorphs α-MnO₂ and γ-MnO₂ with specific surface areas of 98 and 48 m²/g were plasma-synthesized at high voltage (600V) respectively via reduction of KMnO₄ and oxidation of Mn(CH₃COO)₂·2H₂O by radicals NO⁻ and HO⁻ generated in gliding arc plasma medium. The same syntheses operated at low voltage (480V) give the polymorph δ-MnO₂ with specific surfaces of 186 and 289 m²/g. Changes of polymorph and increase of the specific surface are thus recorded when the voltage decreases. These changes are also recorded when the airflow decreases. The catalytic tests of the different MnO₂ in the presence of H₂O₂ reveal the inefficiency of these catalysts for the elimination of Tartrazin Yellow (TY), due to the catalyzed decomposition of H₂O₂ in O₂ and H₂O molecules. At the opposite, the treatment with each catalyst alone (without input of H₂O₂) reveals a significant elimination of TY, which is due to the production of highly oxidizing species as HO⁻ and HO₂ radicals, via the reaction between dissolved oxygen, water and electrons generated by each of the plasma-synthesized MnO₂. The effect is due to the presence of Mn in a mixed valence (III, IV). Photocatalytic tests reveal a significant contribution of solar radiation to the catalytic bleaching process of TY. A synergy between the plasma and each catalyst is recorded during the plasmacatalytic bleaching of TY. Moreover, the plasma temporal post-discharge species positively affect the catalytic properties of plasma-synthesized MnO₂. The second part studies the stability of plasma-synthesized MnO₂ nanomaterials. The results reveal that the modification of MnO₂ plasma-synthesized through ionic species (K⁺, Na⁺, Mg²⁺) enhances its thermal and catalytic stability, compared to un-modified MnO₂ which changes polymorph after heating at high temperature (400°C) and loses its activity after the first catalytic cycle. Thus, gliding arc plasma appears as an innovative and ecological synthesis method of various polymorphs of MnO₂.

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