الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي والبحث العلمي
جامعة قسنطينة 1 – الإخوة منتوري
كليـــــــــة العلوم الد قيـقة

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH
Constantine 1 University – Frères Mentouri
Faculty of Exact Sciences

ANNONCE DE SOUTENANCE

Conformément à la décision n° **19/D3C/2026 datée** du **23 Février 2026** autorisant la soutenance d'une thèse de doctorat, le Vice-doyennat chargé de la post-graduation, de la recherche scientifique et des relations extérieures, a n n o n c e la soutenance publique d'une thèse de doctorat le :

Jeudi 12 Mars 2026 à 16H00

Lieu : A la salle de conférences sise au Campus Chaab Erssas - Constantine 1 – Frères Mentouri
F i l i è r e : **C H I M I E**
Spécialité : Chimie analytique et environnement

Doctorante: **BELAHLOU Khalida**

Sur le thème : « Synthèse verte des nanostructures d'oxyde de zinc / métal pour la dégradation photocatalytique des composés organiques en solution aqueuse».

Devant le jury d'examen :

	Nom et prénoms	Grade	Etablissement d'appartenance
P r é s i d e n t e	SERAGHNI Nassira	Professeure	Université Constantine1, Frères Mentouri
Directrice de thèse	BELAIDI Sihem	Professeure	Université Constantine1, Frères Mentouri
Examinateurs	BICHA Sabrina	Professeure	Université Constantine1, Frères Mentouri
	ARRIS Sihem	Professeure	Université Salah Boubnider Constantine 3
	REMACHE Wassila	M.C.A	Université Mohamed Seddik Benyahia -Jijel
	MAMERI Yazid	M.C.A	Université Salah Boubnider Constantine 3

Abstract

This thesis is part of the development of sustainable processes for water purification, with a focus on the green synthesis of semiconductor nanomaterials based on zinc oxide (ZnO), magnesium oxide (MgO) and $Zn_{1-x}Mg_xO$ nanocomposites. The materials were developed from extracts of Retama sphaerocarpa (RT), used as reducing agents, stabilisers and modulators of structural and optical properties.

The nanoparticles (NPs) and nanocomposites (NCs) obtained were characterised using various techniques (XRD, FTIR, SEM/EDS, BET and UV-Vis), confirming the formation of pure crystalline phases and the reduction in the band gap, attributed both to the effect of the phytochemical compounds in the plant extract and to the formation of the NCs.

The photocatalytic efficiency of the synthesised semiconductors was evaluated for the degradation of Linuron (LNR), a persistent herbicide from the phenylurea family, in aqueous solution under different irradiation sources, including sunlight.
Spectrophotometric analyses (UV-Visible, HPLC) were used to monitor the evolution of LNR in the presence of catalysts.

Preliminary studies have shown that LNR is weakly photolysable under simulated or solar UV-A irradiation, highlighting the need for an effective catalyst. Photocatalysts biosynthesised from RT plant extracts (RT-ZnO) showed remarkable activity, with the RT-ZnO1 sample achieving 95% degradation of LNR after 300 minutes under 365 nm irradiation. This performance was superior to that of chemical ZnO and samples with a high plant extract content. Optimisation of the experimental parameters established that a catalytic dose of 0.5 g/L, a neutral pH and sunlight are the optimal conditions. Furthermore, RT-ZnO1 showed excellent stability, good reusability and a mineralisation capacity of up to 80% after 8 hours, confirming its strong potential for the sustainable decontamination of water polluted by organic pollutants.

In order to improve photocatalytic performance, ZnO was combined with MgO to form Zn1-xMg$_x$O NCs using a green process. The influence of the Zn and Mg substitution ratio (x = 0.2 ; 0.5 ; 0.8) on the degradation efficiency of LNR was studied. The RT-Zn0.5Mg0.5O NCs showed the best activity, ensuring complete degradation of LNR in 180 min and 95% mineralisation of TOC under solar irradiation. Hydroxyl radicals (•OH) were identified as the main reactive species. Tests carried out in natural waters confirmed the stability, durability and reusability of RT-Zn0.5Mg0.5O, demonstrating its strong potential for real-world environmental applications.

This work shows that green synthesis combined with the design of ZnO/MgO NCs is an effective, environmentally friendly and economically viable approach to developing high-performance, sustainable photocatalysts that can be used in water purification and other environmental and energy applications.