AOPs PhD School

PhD Candidate Profile

Name:

Sandra Yadira Mendiola Alvarez

Research Group (if relevant):

N/A

Research Centre (if relevant):

Laboratorio de Fotocatálisis y Electroquímica Ambiental

Department/School(s) (if relevant):

Facultad de Ciencias Químicas

College:

Universidad Autónoma de Nuevo León

Supervisor(s):

Dra. Aracely Hernández Ramírez

Funding body:

N/A

Area (field) of study:

Removal of sulphonamides on water and NOx removal on gas phase with by advanced oxidation process

Thesis Title:

Sulfonamides degradation and NOx removal using Fe_2O_3-TiO_2/P catalyst under visible radiation

Abstract:

In this work, the degradation of three antimicrobial drugs, belonging to the bacteriostatic agents group of sulfonamides: sulfadiazine (SDZ), sulfamerazine (SMRZ) and sulfametazine (SMTZ) and the removal of NOx, under visible radiation, using P-doped Fe_2O_3-TiO_2 mixed oxide as photocatalyst was studied. The degradation and mineralization of SNs was monitored by high-performance liquid chromatography and total organic carbon analysis, respectively. The biodegradability index was calculated by the ratio of the biological oxygen demand to the chemical oxygen demand.The effect of the percentage of Fe and P on the catalyst, the solution pH and the catalyst loading on the photocatalytic degradation under visible radiation of sulfametazine and the mixture of the three sulfonamides were evaluated using response surface experimental designs (Box-Behnken and Central Composite) for the determination of the optimal conditions to carry out the photocatalytic process.

Once the optimal degradation conditions were found, the heterogeneous photocatalysis (0.5αFe-Ti/P1.0) was coupled to an oxidation process with 5 mM potassium persulfate, which

allowed to reduce the time for the complete degradation of the three SNs and achieve a mineralization percentage of 68% and a biodegradability index of 0.48. The intermediates detected by gas chromatography coupled to mass spectrometry were pyrimidine and hydroquinone, as well as their hydroxylated arrangements; while short chain carboxylic acids (oxamic, oxalic, sulfanilic and acetic acids) were identified as byproducts by ion exclusion chromatography.

Once the best catalyst for the degradation of the mixture of three sulfonamides (0.5αFe-Ti/P1.0) was found, its photocatalytic activity in the removal of NOx in gas phase (750 µg/L) using a continuous flow reactor was checked. The photocatalytic activity of the Ti, Ti-P1.0, 0.5αFe-Ti and 0.5αFe-Ti/P1.0 materials was evaluated under UV and visible radiation. The 0.5αFe-Ti catalyst allow to obtain in 1 h removal percentages of 100 and 91% under UV and visible radiation, respectively. The greater activity of 0.5αFe-Ti in NOx removal was attributed to the presence of Lewis sites in its surface. The surface acidity was studied by ammonia adsorption and their analysis by FTIR technique. In addition, the adsorbed nitrogen species (NO_3^- and NO_2^-) present on the materials surface after NOx removal were determined by FTIR showing that 0.5αFe-Ti generates reaction suproducts of lower toxicity than NO_2.

Collaborations:

N/A

Publications:

(1) S. Mendiola; M. Hernández; J. Guzmán; L. Garza; L. Hinojosa. “Phosphorous-doped TiO_2 nanoparticles: synthesis, characterization, and visible photocatalytic evaluation on sulfamethazine degradation”. Environmental Science and Pollution Research, 2018, 26, 4180-4191.

(2) S. Mendiola; M. Hernández; J. Guzmán; M. Maya; A. Caballero; L. Hinojosa. “A novel P-doped Fe_2O_3-TiO_2 mixed oxide: Synthesis, characterization and photocatalytic activity under visible radiation”. Catalysis Today, 2019, 328, 91-98.

(3) S. Mendiola; C. Palomino; G. Turnes; M. Hernández; J. Guzmán; L. Hinojosa. “Coupled heterogeneous photocatalysis using a P-TiO_2-αFe_2O_3 catalyst and $K_2S_2O_8$ for the efficient degradation of a sulfonamide mixture”. Journal of Photochemistry and Photobiology A: Chemistry, (Enviado).

Presentations:

(1) IV Congreso Internacional de Química e Ingeniería Verde Monterrey, N.L., México ,6 - 8 de September 2017..

(2) XV Congreso Mexicano de Catálisis y VI Congreso Internacional, Monterrey, N.L., México. 1 - 6 October 2017.

(3) 3rd Iberoamerican Conference on Advanced Oxidation Technologies (III CIPOA) and 2nd Colombian Conference on Advanced Oxidation Processes (II CCPAOX). Medellin (Guatapé), Colombia, 14 – 17 November 2017.

(4) 10th European meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA10). Almería, Spain. 4 –8 June 2018.

(5) 1er Congreso Internacional de NanoBioIngeniería, Monterrey, Nuevo León, México. 7 - 9 November 2018.
(6) Jointly Meeting of the Italian Zeolite Association, Czech-Italian-Spanish Conference, Italian Interdivisional Catalysis Group. Amantea, Italy. 11-14 June 2019.
(7) V Congreso Internacional de Química e Ingeniería Verde, Monterrey, N.L., México. 4 - 6 de September 2019.
(8) VI Iberoamerican Conference on Advanced Oxidation Technologies, Natal, RN, Brazi. 18 - 22 de November 2019.