ABSTRACT

This study enthusiastically highlights for the first time, a new nano-photocatalyst (reconstruction of $SnO_2/MnO_2/Al_2O_3/TiO_2$ on MCM-41 SiO_2@KOH-modified pine bark activated carbon harnessed for the photodegradation of two pharmaceuticals, which are contaminants of emerging concern, namely tetracycline (TCL) and sulfamethoxazole (SMX), using the response surface methodology. The MCM-41 structure-directing agent and a new low-cost/locally synthesized activated carbon were used as support for semiconductor nano-photocatalyst, which in turn enhanced its surface area/pore structure and photoactivity through the decrease in electron–hole pair recombination. The optimal desirability histogram and ramp functions showed each optimal or desirable condition for each dependent variable (factor) and independent variable (response). In overall, after all targets have been achieved, the ramp function plots gave a desirability of 0.689 (68.9%) for the photodegradation of TCL and a desirability of 0.602 (60.2%) for the photodegradation of SMX. The response surface methodology (RSM) technique showed that experimental run 3 gave maximal condition for the photodegradation of TCL with 99.4% of photodegradation of TCL achieved in 30 min, with half-life (time taken for 50% of 20 mg/L of TCL to photodegrade) of 3.04 min and a quantity of 9.94 mg/g of TCL photodegraded. Likewise, experimental run 10 gave maximal condition for the photodegradation of SMX with 94.95% of photodegradation of SMX achieved in 60 min, with half-life (time taken for 50% of 20 mg/L of SMX to photodegrade) of 5.58 min and a quantity of 9.50 mg/g of SMX photodegraded. This lucidly shows that this nanophotocatalyst is more efficient for the photodegradation of low initial concentration of TCL and SMX, when compared to the high initial concentrations of these antibiotics studied.