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Spent Li-ion batteries derived synthesis of boron doped RGO-Bi_2WO_6 for photocatalytic degradation of antibiotics

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ABSTRACT

The aim of the current study is to resolve two significant environmental cleanup issues. The first involves recycling the spent lithium-ion batteries (LIBs) and the second involves the degradation of the antibiotics found in water. It has been possible to synthesize reduced graphene oxide (RGO) from used LIBs that have also been doped with boron (BRGO). A nanocomposite (BWO/BR) is formed when BRGO and a visible active Bi_2WO_6 (BWO) are mixed together. The structural, morphological, and spectroscopic characterizations confirm the formation of BRGO, BWO, and BWO/BR nanocomposite. The antibiotics tetracycline hydrochloride (TCH) and ciprofloxacin (CIP) have been tested for photocatalytic degradation with all three of the newly made materials. It is found to decrease the bandgap of BWO (2.73 eV) to 2.22 eV upon combining with BRGO. Under visible light, BWO/BR exhibits elevated TCH degradation (93 %), which is found to increase in the presence of sunlight (95 %). In the presence of BWO/BR, the degradation of CIP was reported to be 72, 95, and 97.5 % in UV, visible, and sunlight, respectively. The effect of reaction conditions like pH, amount of catalyst and initial concentration were examined towards degradation of TCH and CIP in presence of BWO/BR. It has been discovered that pH 6 and 8 are ideal for TCH and CIP, respectively. Studies on TCH and CIP degradation in pharmaceutical effluent were also conducted; in the presence of BWO/BR and visible light, the degradation efficiencies were determined to be 69 and 72 %, respectively. All of the zone of inhibition of *E. Coli,* L. *monocytogenes, S. typhimurium,* and *S. aureus* were examined in presence of BWO/BR before and after exposure to visible light for 90 min, during which time a near-zero zone of inhibition was seen. There were investigations using liquid chromatography-mass spectrometry (LC-MS) to identify the intermediate products of TCH and CIP degradation.

1. Introduction

The presence of antibiotics in our environment, especially in water sources, has become a major worldwide concern with far-reaching effects [1,2]. In earlier decades, antibiotics were hailed as life-saving wonders of modern medicine and are now posing a hazardous threat due to their extensive accumulation in aquatic ecosystems [3,4]. Antibiotics are widely used in both human and veterinary medicine, and they are also used in agricultural practices, which has led to this worrying trend. Due to less awareness about toxicity, improper disposal to rivers, lakes, and oceans is observed [5]. These powerful medications represent a serious risk to human health as well as upsetting delicate ecological balances [6]. Therefore, addressing this global environmental health crisis is in high demand, which targets post-disposal treatment of antibiotics in an aqueous system [7,8].

Tetracycline hydrochloride ((4S,6S,12aS)−4-(dimethylamino)−1,4,4a,5,5a,6,11,12a-octahydro-3,6,10,12,12a-pentahydroxy-6-methyl-1,11-dioxonaphthacene-2-carboxamide) and ciprofloxacin (1-cyclopropyl-6-fluoro-4-oxo-7-piperazin-1-ylquinoline-3-carboxylic acid) are the two extensively produced and used pharmaceuticals due to high antimicrobial activity and low cost. The improper metabolism, unused and expired antibiotics released by pharmaceutical industries, and

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