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Short Abstract

Photocatalytic Inactivation of Antibiotic Resistance Genes by Nanocomposites of Carbon Nitride

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Antibiotic resistant bacteria (ARB) carrying the antibiotic resistant gene (ARG) is an emerging threat. According to CDC, In the U.S., at least 2 million people get infected by different strains of ARBs and at least 23,000 people die from those infection. The current water treatment processes are ineffective to remove such strains of bacteria. As the antibiotic resistant genes are often confined in the plasmid DNA, in this research, a nanocomposite of carbon nitride has been formulated comprising of graphitic carbon nitride, reduced graphene oxide and iron oxide to inactivate plasmid DNAs under visible light. Different characteristic tests confirmed that the composite photocatalyst demonstrated better photocatalytic properties than pure carbon nitride. Two types of plasmid DNAs, pUC 18 (2686 bp) and pBR 322 (4361 bp) containing the ampicillin resistant genes (amp^R) were successfully inactivated by the nanocomposite in presence of hydrogen peroxide and visible light. Agarose gel electrophoresis confirmed that the supercoiled plasmid DNAs were first converted to single stranded and relaxed circled DNAs followed by complete fragmentation. TEM images successfully captured the images of different stages of DNA fragmentation. The photocatalytic inactivation of plasmids may be attributed to the five possible phenomena in the system, including photocatalytic activity of carbon nitride alone, relaxation of photogenerated charge carriers by reduced graphene oxide, quenching of electron-holes pairs and generation of additional hydroxyl radicals by hydrogen peroxide, photo-Fenton activity by iron oxide in presence of hydrogen peroxide and additional photocatalytic activity of iron oxide alone.