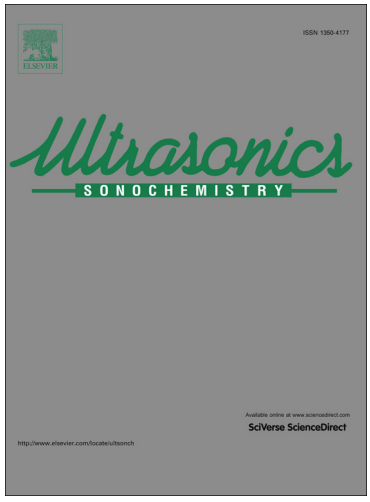

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Enhanced antimicrobial activity of ZnO nanofluids in sonophotocatalysis and its mechanism

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Abstract

This study investigated the inactivation efficiency of ZnO nanofliuds against *E. coli* in sonophotocatalysis with the aeration of nitrogen, oxygen, argon and their mixtures. The results showed that inactivation efficiency was increased when aeration was combined with sonophotocatalysis. Addition of different types of gases could lead to the different inactivation efficiency. The inactivation efficiencies were shown in the following order: no aeration < nitrogen < argon < oxygen <Ar/O_2(3:7) < Ar/O_2(7:3) < Ar/O_2(5:5). The production of hydroxyl radicals was explored to understand the inactivation mechanism. Compared with sonophotocatalysis without aeration, more hydroxyl radicals were produced in sonophotocatalysis with aeration, which could lead to changes of cellular substances. Furthermore, characterization of *E. coli* cells using Raman spectroscopy and FTIR illustrated that sonophotocalysis could affect the cellular substances containing carbohydrates, proteins and P containing molecules. Results suggested that the enhanced antimicrobial activity with aeration was originated from stronger cavitational activity, together with the formation of hydroxyl radicals. Compared to sonophotocatalysis without aeration, more dissolved oxygen was existed in sonophotocatalysis with aeration, which could enhance the formation of hydroxyl radicals.

Keywords: ZnO, sonophotocatalysis, inactivation, hydroxyl radical, aeration, cavitation

1. Introduction

Over the past few years, semiconductor mediated photocatalysis has been extensively investigated as an alternative method for the removal of organic and inorganic pollutants from aqueous stream such as phenols[1-3], dyes[4], pesticides[5], and heavy metals[6]. To enhance the photocatalytic activity of catalyst, researchers not only applied surface or structural modification techniques that