

PLASMA-CATALYTIC TREATMENT OF VOLITILE ORGANIC COMPOUNDS

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Abstract:

Volatile organic compounds (VOCs) are considered as one of the toxic air pollutants generated in urban and industrial areas. The application of non-thermal electrical discharges instead of thermal energy has been shown to be a suitable alternative for the treatment of exhaust gases, especially for low concentrations (<100 ppmv) of contaminants. In the present paper, we describe the synergetic application of plasma and catalytic treatment for the oxidative removal of volatile organic compounds (VOCs).

Keywords: Plasmacatalytic process; Volatile organic compounds; Non-thermal electrical discharge.

Introduction

Volatile organic compounds (VOCs) are considered as one of the toxic air pollutants generated in urban and industrial areas. A lot of researches have been already studied on the decomposition of VOCs. The conventional methods for controlling VOCs are catalytic oxidation, activated carbon adsorption, and etc [1-3]. These technologies, however, associated problems such as costs and energy requirements because many sources of gaseous emissions produce low levels of VOCs in large volume flows. As an example, Table 1 shows the occupational exposure limits for some common volatile organic compounds (VOCs). Most of them are in the range of 100 ppmv and below and the German regulations for industrial off-gases, also shown in Table 1, are even stronger [1].

At these low contamination levels a catalytic oxidation requires a substantial supply of thermal energy to be effective. One of the promising methods to control of VOCs is using nonthermal plasma.

Nonthermal plasma is highly effective in promoting oxidation, enhancing molecular dissociation, and producing free radicals. Moreover the combination of catalyst and non-thermal plasma is also attractive for enhancing the efficiency of VOC destruction and some studies have been carried out elsewhere[1]. In a non-thermal plasma, electrons with high energy can activate the gas molecules by collision processes. If the off-gas contains oxygen and water vapor, oxygen and hydroxyl radicals, which are two of the main species formed in the discharge, can react with the other molecules and contribute in this way to any oxidation process[1].

Non-Thermal Plasma

Non-thermal plasma (NTP) is a new concept of application of gas-phase oxidation processes that can destroy air pollutants. It is an extensively studied advanced oxidation technology (AOT) that envisions production of highly reactive gas-phase free radicals, such as $\cdot\text{O}(\text{}^3\text{P})$ and $\cdot\text{OH}$ that can initiate and sustain a complex chemistry of pollutant