

INFLUENCE OF DIELECTRIC BALLS IN PACKED BED REACTOR OVER PLASMA MECHANISM AND ETHANOL CONVERSION.

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Abstract. The influence of various materials in plasma packed bed reactor has been studied. The influence of the presence of balls of glass, BaTiO₃, BaZr_{0.75}Ti_{0.25}O₃ and Ba_{0.66}Sr_{0.33}TiO₃ on the electrical behavior, ozone formation and ethanol conversion have been investigated. The variation of ethanol conversion as a function of the input power determined from Lissajous curves, shows that the best conversion efficiency is obtained when Ba_{0.66}Sr_{0.33}TiO₃ balls fill the plasma reactor. Addition of platinum as nanoscale particles size increases significantly the ethanol conversion for the same input power. Surprisingly, when platinum is present on the BaTiO₃ balls surface the input power at the same applied voltage, measured by the Manley's method (Lissajous figure) is about half of the value measured for the balls without platinum. This behavior cannot be explained by a catalytic effect, but could be due to a different type of plasma formed in presence of platinum metallic particles.

1. INTRODUCTION

Non thermal plasma technology is a promising process for treatment of exhaust gas flow [1]. The plasma can be created by pulsed corona discharge [2], dielectric barrier discharge [3] or in a dielectric barrier discharge packed-bed reactor [4, 5]. The efficiency of this kind of plasma reactor seems to be increased when the reactor is filled with a high dielectric constant material [6]. Such materials are basically used in micro-electronics [7]. The perovskite BaTiO₃ is especially used because of its high permittivity [8]. By substitution of barium by strontium [9] or titanium by zirconium [10] the dielectric properties can be modified. The position of this dielectric material in the plasma zone [11] and the mechanisms of non thermal plasma formation [12] have been also studied.

The measurement of the energy deposited in the gas phase by plasma formation is often a difficult problem [13]. When the plasma is generated by sinusoidal voltage, the input power is often estimated by the Manley's method [14, 15, 16] which consists to integrate the surface area defined by a Lissajous curve obtained by plotting the charge transferred to the gas phase versus the voltage applied. According to these measurements, the input power depends on the values of reactor capacitance and dielectric constants of the material used to in the reactor [17, 18].

In this work, different dielectric materials synthesized as spherical pellets [19] are used in a packed bed reactor. Their influences on plasma parameters and on ethanol conversion are presented. The influence of the presence of platinum as nanoscale particles supported on dielectric material on plasma formation and ethanol elimination is also studied.

2. EXPERIMENTAL

The non-thermal plasma is of dielectric barrier discharge type. The reactor used (Figure 1) is a Pyrex tube (16 mm of external diameter) with a 4 mm gap between the inner electrode and the tube wall.

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