

CAPILLARY MICROPLASMAS FOR OZONE GENERATION

Hensel K.^a, Leštinský M.^a, Machala Z.^a and Tardiveau P.^b

*a) Department of Astronomy, Earth Physics and Meteorology, Comenius University,
Mlynska dolina F2, 84248 Bratislava, Slovakia*

*b) Laboratoire de Physique des Gaz et des Plasmas, Université Paris Sud,
Bâtiment 210, 91400 Orsay, France*

Abstract. Microplasmas generated by electric discharges on dielectric surfaces and inside confined cavities and pores of dielectric materials attract an attention due to their numerous environmental and other applications. The paper presents the data for ozone generation by microplasmas generated inside porous ceramics foams. The objective has been to evaluate the plasma chemical potential of these microplasmas for generation or removal and selected gaseous and other products.

1. INTRODUCTION

Atmospheric pressure non-equilibrium microplasmas are very attractive for applications in areas such as surface modifications, environmental and biomedical processing. The advantage of the microplasmas is that they produce high densities of chemically active species at relatively low energy consumption without any vacuum equipment requirements. The atmospheric microplasmas can be generated by various types of electric discharges, including hollow cathode and capillary plasma electrode discharges, discharges in porous ceramics and capillaries (honeycombs) or dielectric barrier and coplanar discharges [1].

The capillary microplasmas (microdischarges) generated inside ceramic foams are short-living sparks. They originate from a surface barrier discharge, which develops on the ceramics at low amplitudes of the applied voltage. If the amplitude exceeds a certain value, the charges of the surface discharge enter the ceramics and capillary microdischarges form inside it. The transition of the microdischarges into an arc is suppressed by the small energy stored in the capacity of the electrodes and the connecting cables. The production of the charged particles in microplasmas is limited by the ambipolar diffusion toward the walls of the pores and volume recombination. The capillary microplasmas are relatively cold plasmas with high level of non-equilibrium. Their gas temperature was found close to room temperature, increasing with the oxygen contents in the gas mixture. Due to the high thermal shock resistance of the ceramic foams and effective heat dissipation, overall increase of the temperature in time is relatively small.

The paper presents the generation of capillary microplasmas inside confined cavities of ceramic foams. It briefly describes the physical properties of the microplasmas and focuses on their chemical effects. The plasma chemical effects of the microplasmas were evaluated via the generation of ozone in various mixtures of nitrogen and oxygen. The dependence of ozone generation as a function of discharge power, gas mixture composition and total gas flow rate are presented.

2. EXPERIMENTAL SETUP

Figure 1 shows the experimental setup. The cylindrical discharge reactor consisted of porous ceramic

^a Electronic address: hensel@fmph.uniba.sk, lestinsky.michal@gmail.com, machala@fmph.uniba.sk,

^b Electronic address: pierre.tardiveau@u-psud.fr