

STATISTICAL DESCRIPTION OF BARRIER DISCHARGES AT ATMOSPHERIC PRESSURE

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Abstract. A detailed study of a novel description method for microdischarges based on the statistical analysis of single discharge bursts is presented and applied to small electrode arrays. Furthermore, the interaction between high-speed gas flows and microdischarges in small ducts has been approached presenting first results.

1. INTRODUCTION

Today, barrier discharges (BD) have become the most promising candidate for moderate and atmospheric pressure processing in various fields such as surface modification, thin film deposition, or exhaust gas purification. More recently, the application of atmospheric BDs in microfluidic devices has obtained increasing interest [1]. These micro barrier discharges (μ -BD) provide an ideal non-thermal energy source for surface and gas-phase reactions inside a micro-channel to modify local surface properties or for the deposition of inorganic layers. In both cases, a proper electrical characterization is needed to understand the discharge physics. Due to the restriction of the plasma to microscale dimensions, the effective discharge area and therefore the total charge transferred is small. Samoilovich et al. even described the microdischarges being totally distinguished when decreasing the electrode array below a minimum value [2], which is necessary to deliver the critical charge for a single microdischarge. Consequently, common measuring methods as the Lissajous figure [3] are hardly applicable. In order to overcome this limitation, a novel evaluation tool, which analyses individual discharge bursts and thus delivers statistical information about important operations parameters is applied upon a miniaturized discharge cell. Furthermore, since devices in the microscale range would be advantageously used to reach transonic flow conditions at moderate gas flow rates, the presented evaluation tool is applied to investigate the effect of such flows on the discharge behaviour of μ -BDs. Furthermore, a highly sensitive characterization method is required since the discharges become much weaker at such flow conditions [4]. The interest in igniting a μ -BD within such a channel and the possibility of its characterization is manifold [1]. In this work, it mainly descends from the possible prolongation of the displacement distance of active species to a few centimetres in high velocity flows (compare radical lifetimes reported in [5]).

2. EXPERIMENTAL APPROACH

2.1. Experimental Set-up

For the present investigations two different discharge arrangements as shown in Figure 1 were used, which distinguish mainly by the electrode arrangement and their different discharge areas. As a dielectric layer, an acrylic glass plate with a relative permittivity ϵ_r of 2.3 and a thickness of 2 mm was used, in which the discharge channels are incorporated by conventional micro machining.

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