The Development and Analysis of Plasma Microfluidic Devices

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The increasing demand for miniaturization of instruments and components has generated significant interest in the development of small size plasmas which can be integrated into bio-chips for sensing and detection applications. Microfluidic devices were studied here to determine the potential for lab-on-a-chip applications based on the dielectric barrier discharge (DBD) mode of activation. This type of discharge is usually formed between two parallel electrodes, with a separation between 0.1 to 1mm, where one or both electrodes are covered with a dielectric barrier. Different working conditions were considered: A sinusoidal voltage of up to 9kV peak to peak with frequencies from 10 kHz to 40 kHz has been applied to the electrodes imbedded in PDMS layers. The micro channel width was maintained at 50 and 100 μm, and the pressure was varied between 35kPa and 103kPa, using helium, neon and nitrogen gases respectively, for the formation of the microplasma discharges. This generated micro discharge currents in the range of 0.1 to 7mA, and can be seen as current filaments of about 100ns duration on the time resolved electrical waveform. I-V measurement results obtained show a sharp peak in the discharge current at the breakdown voltage. Results also confirm the dependence of discharge current on frequency, gas composition, microchip geometry and flow rate. Characterization of these micro-discharges will be done in the future using time resolved optical and electrical measurements.

Keywords
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Discharge current