THE DEVELOPMENT AND ANALYSIS OF PLASMA MICROFLUIDIC DEVICES

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The evolution of microplasmas, based on 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. Microplasmas are cost effective and highly efficient electrical discharges operated at pressures greater than several hundreds of Torr to atmospheric pressure and above.

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.

Preliminary I-V measurement results show a sharp peak in the discharge current at the breakdown voltage, and also the dependence of discharge current on gas composition (Fig 1). Results also show the dependence of discharge current on frequency (Fig 2), microchip geometry and flow rate. The characterization of microplasmas imbedded into micro-fluidic devices will be done in the future using the measured electrical characteristics combined with various optical based techniques (e.g. optical emission spectroscopy) in order to determine the properties of the microplasma.

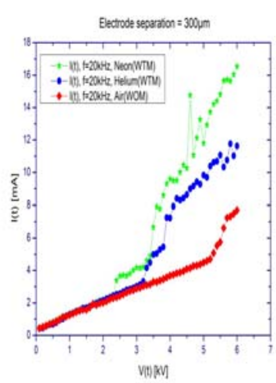

Fig 1

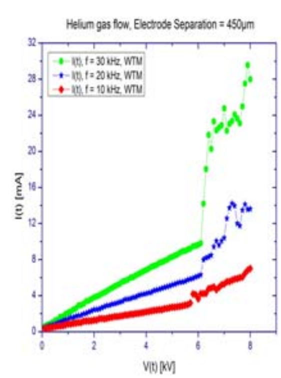

Fig 2

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