Field Emission Microplasma Actuated Microchannel Flow\textsuperscript{1} SIVA SASHANK THOELETI, GAYATHRI SHIVKUMAR, ALINA ALEXEENKO, Purdue University — Flow actuation by dielectric barrier discharges (DBD) involve no moving parts and provide high power density for flow enhancement, heating and mixing applications in microthrusters, micropumps and microcombustors. Conventional micro-DBDs require voltages ~ kV for flow enhancement of a few m/s for 500 \( \mu \text{m} \) high channel. However for gaps <10 microns, field emission lowers the breakdown voltage following modified Paschen curve. We consider a micropump concept that takes advantage of the field emission from a micro-DBD with dielectric thickness of 3 \( \mu \text{m} \) and a peak voltage of -325 V at 10 MHz. At 760 Torr, for electrode thickness of 1 \( \mu \text{m} \), Knudsen number with respect to the e-nitrogen collisions is 0.1. So, kinetic approach of particle-in-cell method with Monte Carlo collisions is applied in nitrogen at 300 K to resolve electron (\( n_e \)) and ion (\( n_i \)) number densities. Body force, \( f_b = eE(n_i-n_e) \), where, \( e \) is electron charge and \( E \) is electric field. The major source of heating from plasma is Joule heating, \( J.E \), where \( J \) is current density. At 760 Torr, for \( f_{b,\text{avg}} = 1 \text{ mN/cubic mm} \) and \( J.E = 8 \text{ W/cubic mm} \), micro-DBD induced a flow with a velocity of 4.1 m/s for a 64 mW/m power input for a channel height of 500 \( \mu \text{m} \). The PIC/MCC plasma simulations are coupled to a CFD solver for analysis of the resulting flow actuation in microchannels at various Reynolds numbers.

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