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Field Emission Microplasma Actuated Microchannel Flow[1] SIVA SASHANK THOLETI, 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 $\sim$ kV for flow enhancement of a few m/s for 500 μm 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 μm and a peak voltage of -325 V at 10 MHz. At 760 Torr, for electrode thickness of 1 μm, 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, $\mathbf{f_b} = e\mathbf{E}(n_i\text{-}n_e)$, 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 $f_{b,avg}$ = 1 mN/cubic mm and **J.E**= 8 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 μm. 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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