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Microdischarge integration on silicon based devices.[1]

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DC Microhollow cathode discharges (MHCD) were first introduced in the mid 90's [1]. Due to their dimensions and their large surface to volume ratio, the produced microplasmas remain cold and can stably operate at atmospheric pressure in the normal regime provided the cathode area is not fully utilized [2]. Silicon processing intensively developed for microelectronic devices offers many opportunities to design new, original and efficient devices to produce high density microplasmas. [3] Our microreactors are made using processes including steps of oxidation, lithography, magnetron deposition and etching. In our device configuration, the dielectric separating the two electrodes is made of thermal SiO_2 and is 6 um thick so that a very high electric field is obtained before breakdown. However, in our device configuration, no field effect assisted breakdown was evidenced. With a cathode of silicon, the operation of our microdischarge arrays is very unstable and produces many current spikes that significantly damage the microcavities and lead to device failure. The mechanism responsible for this unstable operation and short lifetime was observed by other groups [4] and were investigated [5]. The different possibilities to enhance the stability of microdischarges made from silicon wafers will be discussed. One of them consists in using a thin metal film on the silicon cathode. The devices were then tested in 3 different gases (He, Ar N_2) and in the air. We will show that a very stable operation can be obtained using this new configuration. The lifetime of the microreactors with a confined cathode is significantly enhanced. [1] K.H. Schoenbach et al., Appl. Phys. Lett. 68 (1996) 13–15 [2] T. Dufour et al. , Appl. Phys. Lett. 93 (2008) 71508 [3] J.G. Eden et al., J. Phys. D: Appl. Phys. 36 (2003) 2869–77 [4] C. Sillerud et al. , Physics of Plasmas, 24, 033502 (2017) [5] V. Felix et al., PSST 25 (2016) 025021

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