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FUNDAMENTAL ASPECTS IN THE PLASMA SURFACE INTERACTION DURING PLASMA STERILIZATION

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Abstract. The inactivation of bacteria in oxygen or hydrogen containing low pressure plasmas is investigated by mimicking the plasma exposure with a dedicated beam experiment employing argon ions, oxygen molecules/atoms and hydrogen atoms . Thereby, fundamental inactivation mechanisms can be revealed. It is shown that the impact of O atoms or H atoms has no effect on the viability of bacterial spores and that no etching of the spore coat occurs up to an O and H atom fluence of 3.5×10^{19} cm^{-2}. The impact of argon ions with an energy of 200 eV does not cause significant erosion for fluences up to 1.15×10^{18} cm^{-2}. However, the combined impact of argon ions and oxygen molecules/atoms or H atoms causes significant etching of the spores and significant inactivation. This is explained by the process of chemical sputtering, where an ion induced defect at the surface of the spore reacts with either the incident bi-radical O_2 or with an incident O atom or H atom. This leads to the formation of CO, CO_2 and H_2O and thus to erosion. This beam results are compared to a broad sterilization campaign using an ICP reactor in a European round robin experiment BIODECON. Strategies for optimizing the plasma sterilization processes will be presented.