Determination of effective UV/VUV radiation of a low pressure inductively coupled plasma for sterilization of spores

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Résumé
Radiation is an important sterilizing agent of a low pressure plasma. Determination of effective wavelength ranges is a crucial step in designing plasma sterilization machines. This contribution focuses on linking a wavelength range to a sterilization efficiency.

Introduction

Plasma sterilization of thermolabile implants is of growing interest as toxic sterilants such as ethylene oxide are tried to be avoided. Additionally residual biomolecules on used medical tools is an indispensable problem. Residuals like lipopolysaccharides can lead to a septic shock, and prions to Creutzfeldt-Jakob disease. Plasma sterilization provides a process which combines sterilization and decontamination.

Experimental setup and results

A low pressure double inductively coupled plasma reactor (DICP) is used for the investigation of the removal of spores [1]. Argon, nitrogen, oxygen and hydrogen are used at a pressure of 5-20 Pa. Rf-power up to 5 kW can be fed through two coils, one at the bottom and one on the top of the reactor. Langmuir probe measurements yield in spatially resolved electron temperature and density. Emission spectroscopy is performed with a VUV- and an Echelle spectrometer. These absolute calibrated spectrometers cover a wavelength range from 112 to 800 nm. A Hiden mass spectrometer measures the density and energy distribution of ions and neutrals.

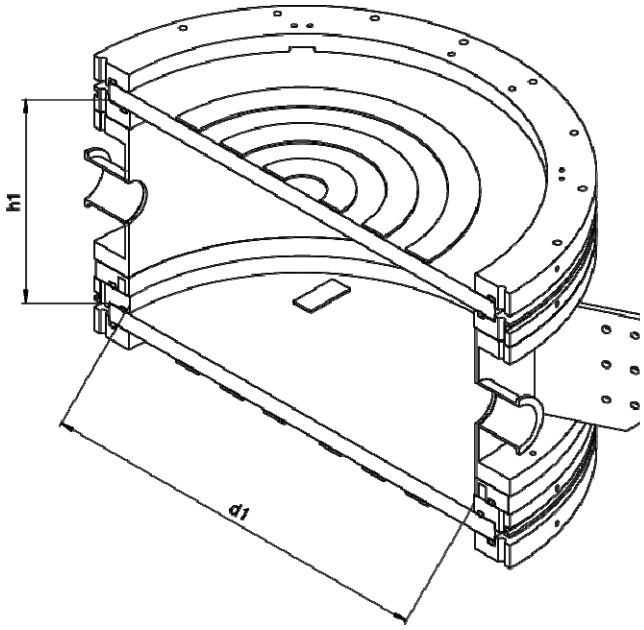

Fig. 1: DICP reactor: d1 = 40 cm, h1 = 20 cm

Different bacterial and fungal spores such as *B. atrophaeus*, *B. subtilis* or *A. niger* are treated at different plasma parameters as well as the spores are covered by different cut-off filters in order to determine the radiation dependency of these spores. Mixtures of different gases allow a selective sterilization of spores in the VUV range. It can be shown that *B. atrophaeus* spores are sensitive to radiation between 235 and 300 nm. In contrast to this *A. niger* spores are resistant to radiation above 235 nm. VUV radiation is needed to sterilize *A. niger* spores.

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References

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