

Microwave Plasma Torch for Bacterial Sterilization

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The interaction between plasma and medical tissue has been investigated with growing interest since non-thermal atmospheric discharge sources were established. With atmospheric plasmas it is possible to treat materials which are not resistant to vacuum, much as living organisms. In our group, a microwave plasma torch for bacterial sterilization at atmospheric pressure has been developed and tested.

The plasma torch was specially designed for the purpose of high efficiency plasma output for a given power input under low gas temperature. All the functional units, including the torch, a power supply, etc., are incorporated in a trolley. The torch is placed on a counterweighted arm in order to use it flexibly. Moreover the torch can be used vertically and at angles. Ar gas of 3 slm is applied from the base of the torch and microwave power of 2.45 GHz is applied to the electrodes. The torch produces a glow-like discharge plasma and this plasma is stable for long times.

The gas temperature at the output of the torch, measured by a thermocouple, is relatively high (90 degrees), however the gas temperature decreases with distance from the torch. At a position 20 mm away from the torch the plasma/gas temperature is 32 degrees. The plasma can sterilize bacteria but doesn't harm human skin.

Escherichia coli (e-coli) bacteria (and others), cultured on agar plates, are used for the experiments. When the culture is placed 20 mm away from the output of the torch for 2 minutes, an effect on the bacteria can be observed: in a circle of 40 mm in diameter, the bacteria are sterilized for the most part. This means that the plasma density at this position is high enough for bacterial sterilization although the plasma density is lower than at the plasma production region. The sterilized area is a little larger than the opening of the torch. The boundary is a little fuzzy because the boundary of the plasma is not sharp.