Bactericidal effect in different gas compositions using 
Surface Micro-Discharge (SMD) plasma

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The usage of cold atmospheric plasma for biomedical 
application is a rapidly growing field of research with a wide 
application spectrum. Here atmospheric plasmas, as the 
application of which has been derived and inspired from the 
semiconductor fabrication research as well as the space 
research, have been utilized to inactivate microorganisms 
such as bacteria, spores and viruses. There are still many 
unclear mechanisms, e.g. how the cold atmospheric plasma 
interact and inactivate microorganisms. One possible answer 
is that the reactive species play an important role by making 
the cell wall of microorganisms permeable and penetrate to 
the inside.

The bacteria samples, Escherichia coli inoculated on agar, are 
treated by a Surface Micro-Discharge (SMD) electrode at 
atmospheric pressure. The electrode consists of a grounded 
planar metal plate, and a metal mesh with a dielectric in 
between. The plasma discharge is produced on the mesh 
electrode side by applying high voltage in the kilovolt range 
(peak-to-peak) at several kilohertz. The bacteria samples are 
placed 6mm away from the electrode.

The SMD-electrode is placed into a vacuum sealed chamber. 
Using this chamber, the gas composition for the plasma 
environment can be manipulated by leading different gas 
mixtures into the chamber. At a constant flow rate of 2slm, 
the chamber is filled with the gas mixture after less than 10 
minutes. During this filling process, the exhaust valve of the 
chamber is open so that the pressure in the chamber remains 
constant at the ambient pressure.

The plasma is ignited in different gas conditions, by changing 
the ratio of oxygen and nitrogen. The electrical property of 
the discharge is then studied for different conditions. 
Compared to the bacterial experiment, using E.coli as a 
testing microorganism, the possible major and minor players 
for bacterial inactivation by the atmospheric plasma is 
discussed.