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Development and Ion-Optical Simulation of an Electron-Impact Ionization Time-of-Flight Mass Spectrometer

handed in by

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Abstract

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APP	Atmospheric Pressure Plasma
C. Sphaerospermum	Cladosporium Sphaerospermum
DBD	Dielectric Barrier Discharge
OES	Optical Emission Spectroscopy

1 | Introduction

2 | **Scientific Context**

3 | Theory and Methods

In this chapter the theoretical background and the methods used in this work are presented. This includes the collection of research on the fungal species *Cladosporium sphaerospermum*, as well as the atmospheric pressure plasma and the different processes that lead to the sterilization of the mould as they interact.

3.1 *Cladosporium sphaerospermum*

Cladosporium sphaerospermum (*C. sphaerospermum*) is a species of fungus. Fungi are a large group of eukaryotic organisms¹ that include yeasts, moulds and common mushrooms. It is a black mould that is commonly found in indoor environments, especially in areas that are damp or have high humidity. It was first described by a German mycologist, Albert Julius Otto Penzig, in 1886 from decaying citrus plant material in Italy [2]. *C. sphaerospermum* primarily reproduces asexually through the production of conidia, which are non-motile spores² formed at the tips of hyphae³. These spores are easily dispersed through the air, allowing the mould to rapidly spread into new environments. Moulds like *C. sphaerospermum* require humid conditions because moisture is essential for spore germination⁴. In dry environments, spores usually remain dormant [1].

¹Organisms whose cells have a membrane around their nucleus, which includes animals, plants and fungi.

²Spores not capable of movement.

³Long, branching structures that grow from their tips. They give moulds their furry appearance.

⁴The process by which a spore begins to grow new hyphae.

3.1.1 Growth and Morphology⁵

C. sphaerospermum has a darkly-pigmented mycelium⁶ that can appear black or dark green. The colonies of the mould are typically flat and have more of a powdery appearance than other moulds. It is typical for fungi of the *Cladosporium* family to have branching, tree-like hyphae on whose ends conidia are formed in chains.

In addition to a humid environment optimal conditions for the growth of *C. sphaerospermum* include a temperature of 25 °C. It is however a psychrophilic fungus⁷ and can grow at temperatures as low as -5 °C [2]. It nourishes through saprotrophic nutrition, which is the process of using decaying or dead organic matter as a source of nutrients. This is why it is commonly found in decaying plant material, where it was also discovered. The conversion of starch, cellulose and other compounds such as carbon dioxide provides the energy needed for growth.

3.1.2 Ecological Role and Habitat

Like many fungi *C. sphaerospermum* plays an important role in the ecosystem as a decomposer. It breaks down dead organic matter, recycling nutrients back into the soil, where it thrives. This process is important as it fertilizes the soil and allows for the growth of new plants, enabling the life cycle. Because of its resilience to different conditions it is able to grow in many different environments which include anthropogenic places like inside of buildings. In humid areas and on porous surfaces, such as wood or concrete walls it can build mycelium and produce new spores. The easily dispersed spores

While fungi, like *C. sphaerospermum*, are able to bind carbon dioxide from the atmosphere they are not a feasible option for carbon capture or conversion at larger scales.

⁵The study of the structure of organisms.

⁶A network of branching hyphae.

⁷An organism that is able to grow in very low temperatures.

3.1.3 Effects on Human Health

3.1.4 Response to Radiation

3.2 Atmospheric Pressure Plasma

3.3 Optical Emission Spectroscopy

3.4 Dielectric Barrier Discharge

3.5 Sterilization Mechanism

3.5.1 Reactive Species

3.5.2 Radiation Effects

4 | **Experimental Setup**

5 | Results

6 | Conclusion

References

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Anhang