Battery Operated, Room Temperature Atmospheric Plasma Jet for Biomedical Applications

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Atmospheric pressure cold plasmas (APCPs) have received a lot of attention due to novel applications such as surface and materials processing, synthesis of nano materials, and biomedical applications. Among them, biomedical applications of the APCPs, for example, sterilization, are of practical interest. In biomedical applications, a plasma jet which generates a plasma plume in an open space (surrounding air) rather than in a confined discharge gap has many advantages over a traditional dielectric barrier discharge (DBD) device. However, regardless of whether the plasma jet is driven by direct current (DC), kHz alternating current (AC), radio-frequency (RF) current, microwave (MW), or pulsed DC, line AC power of 110 V, 60 Hz (in US, Canada, Japan) or 220 V, 50 Hz (in Europe, Australia, Africa, China) is required to power the device. This has limited the portability of the device and is impractical where line power is not readily available, for example, in rural areas and battlefields. In addition, most of the reported plasma jet devices use noble gases or mixtures of noble gases with a small amount of O_2 as the working gas. There are relatively few plasma jets using ambient air as the working gas, and efficient and portable atmospheric plasma jets using air as the working gas have a large market.

In this report, a battery driven, room temperature atmospheric plasma jet is described. Although the plasma is driven by 12 V DC, the discharge has a frequency of about 20 kHz. Each pulse lasts for about 100 ns with a peak current of about 6 mA. Decontamination experiments show that the plasma emitted from this source not only deactivates the cells on the biofilm, but also penetrates through the 25.5 μm thick *Enterococcus faecalis* biofilm killing the bacteria. This is believed to be the thickest biofilm penetrated by a room temperature plasma jet.

Fig. 1. Photograph of the air plasma flashlight