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Generation Method and Physical Features of a Flexible Floating Dielectric-Barrier-Discharge Based on a Microscale Electrode Configuration

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Cold atmospheric plasma (CAP) can be used in wound healing process, which has the synergistic effect of coagulation, disinfection and tissue regeneration [1-3]. Among various types of CAP generators, the dielectric-barrier-discharge (DBD) plasma generator with the treated skin or other living tissues as the grounded electrode has been developed, which can directly generate CAPs on the surface of the treated organisms [4]. However, the CAP generator usually has a rigid structure, which cannot be bended or conformed to irregularly shaped objects [5]. The lack of flexibility of the discharge plasma seriously limits its actual applications as a wearable device.

In this study, a flexible floating dielectric-barrier-discharge (FF-DBD) plasma generator is fabricated using the microscale flexible materials, including the polydimethylsiloxane (PDMS) as the dielectric barrier layer and the conductive hydrogel as the powered electrode, and operates at an open atmosphere with human body or pigskin as the grounded electrode. The electrical and optical characteristics of the produced FF-DBD air CAPs are studied under different operating conditions. The experimental results show that a mild and stable air CAP can be produced driven by a high-voltage alternating-current power supply with a discharge current less than 10 mA, as shown in Fig. 1. And a large amount of reactive oxygen and nitrogen species (RONS) are produced on the surface of the treated materials. In addition, during the discharge process, there are no obvious electric shock and burning sensation if a human finger works as the grounded electrode. Production of the novel flexible air CAPs is helpful for promoting the bio-medical applications of plasmas in future.

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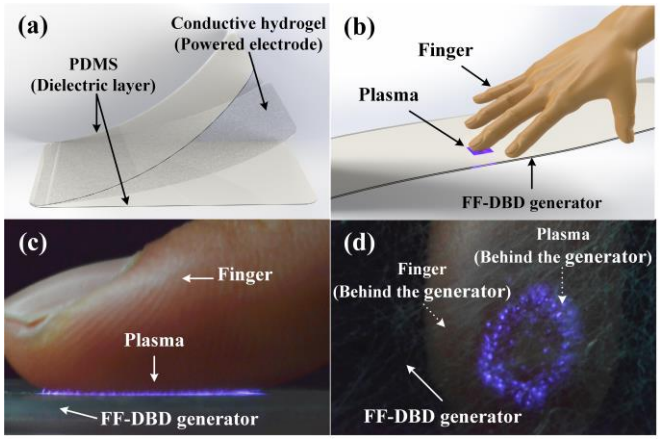

Figure 1. Schematic of the FF-DBD plasma generator (b) and its discharge region (b), typical discharge images in a side view (c) and top view (d). The driving frequency and discharge voltage of the HVAC power supply are 16 kHz and 2.8 kV, respectively.