Application of plasma-bullet propagation to hydrophilic treatments of an interconnected porous scaffold

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An atmospheric pressure plasma jet employing dielectric barrier discharge of helium gas is known to be a source of plasma bullets, which propagate in high-purity helium gas channels. A plasma bullet propagates to the direction independent of gas-flow direction, and nicely separated when they encounter branches of gas channels. We have applied these characteristics of plasma bullets to hydrophilic treatment of internal surfaces of an interconnected porous scaffold. The scaffold employed in this work is a hydrophobic treated glass filter with a thickness of 3.15 mm and a pore-channel diameter of 160-250 μm. Plasma bullets injected from one side of the scaffold have penetrate it and ejected from the other side. Water permeability of the scaffold has been markedly improved after the treatment with the plasma-bullet penetration.

1. Introduction

Atmospheric pressure plasma jets (APPJs) have been widely used for various surface treatments. Its unique nature involving "plasma bullets" [1] may be used for the treatment of internal surfaces of an interconnected porous scaffold used in bone-regeneration. There are few reports which discuss utilization of plasma bullets for such treatment, while there are extensive works using low pressure plasma [2] or those using an APPJ as a simple jet [3].

2. Experimental Setup

We have irradiated a helium APPJ to a hydrophobic treated glass filter, instead of expensive HA or β-TCP, of which thickness and pore channel diameter are 3.15 mm and 160-250 μm, respectively.

3. Results and discussion

Figure 1 show time-evolution of plasma bullets on *the back side* of the APPJ-irradiated glass filter, which indicates that the bullets penetrate the glass filter and exit out of its back side. Figures 2(a) and 2(b) show that water permeability of *the back side* of the glass filter before and after the treatment for 10 min. We can see marked improvement in water permeability of the hydrophobic glass filter after the treatment. These results indicate that the internal surfaces of the hydrophobic glass filter have become hydrophilic by propagation of plasma bullets.

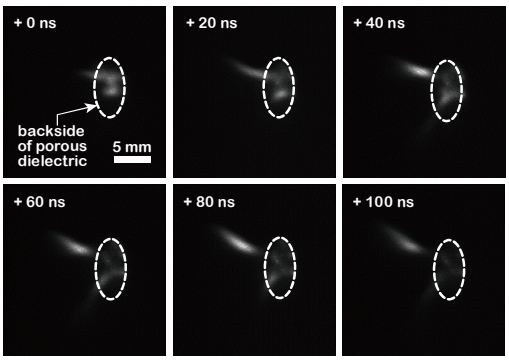

Fig. 1 Propagation of plasma bullets ejected from the glass filter.

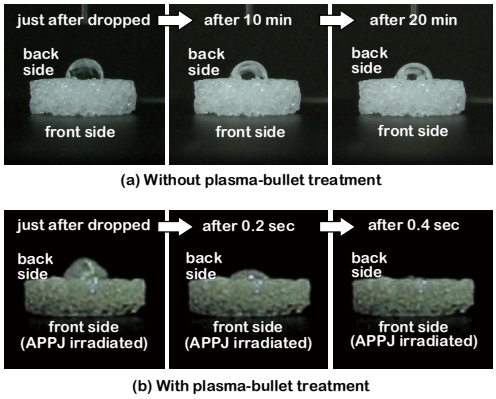

Fig. 2 Water permeability of the glass filter before and after the plasma-bullet treatment.

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