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プラズマ弾丸伝搬による連続多孔質誘電体内部の親水化
Hydrophilic Treatment of Inner Surfaces of a Continuous Porous Dielectric Using Propagation of Plasma Bullets

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1. Introduction

An atmospheric pressure plasma jet (APPJ) 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. These unique features of "plasma bullets" may be used for the treatment of internal surfaces of an interconnected porous scaffold used in bone regeneration, which are preferably made of hydroxyapatite (HA) or ß-tricalcium phosphate (TCP).

2. Experimental procedure

We have irradiated a helium APPJ to a glass filter. The glass filter is used as a substitute of a scaffold made of expensive HA or β-TCP. The thickness of the glass filter is 3 mm. The pore channel diameter of it is 160-250 or 40-100 μm. The scaffold was hydrophobic treated using fluorinated compounds before APPJ irradiation. Plasma bullets were injected from one side of the scaffold. We have expected that the bullets penetrate the scaffold and ejected from the other side of it. In order to confirm the hydrophilization inside the scaffold, 3 μL of water droplets were dropped on the cross section of the half cut glass filter, and we observed the progress.

3. Results and discussion

Figures 1(b-1) to 1(b-7) show time-evolution of plasma bullets on the back side of the APPJ-irradiated glass filter, which suggests that the bullets penetrate the glass filter and exit from its back side. Figures 2(a-1) and 2(b-1) are photographs after 25 minutes after dropping water droplets on the cross section of the glass filter before plasma treatment. Figures 2(a-2) and 2(b-2) show that water droplets instantaneously penetrate the cross section as a result of doing the same thing after the plasma treatment. These results indicate that the internal surfaces of channels in the glass filter have become hydrophilic by propagation of plasma bullets through the scaffold.

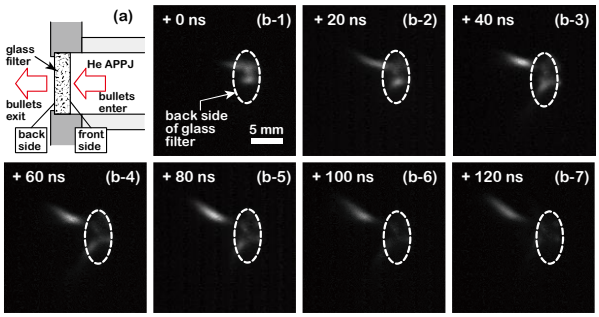

Fig. 1 Propagation of plasma bullets out of a glass filter.

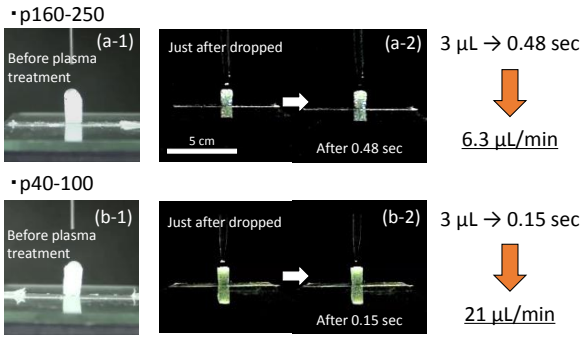

Fig. 2 Improvement of the hydrophilicity of the cross section of the glass filter.

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