The Property of Adhesion and Biocompatibility of Silicon and Fluorine Doped Amorphous Carbon Films

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About our Study

In this study, we developed **silicon and fluorine doped amorphous carbon (a-C:H:Si:F) film** using radio frequency plasma enhanced chemical vapor deposition (RF-PECVD) method, which exhibitis both **high adhesion** of silicon-incorporated interlayer and **excellent biocompatibility** of fluorine doped amorphous carbon (a-C:H:F) film (**Fig. 1**), aiming at shortening the film deposition time. In order to fabricate a-C:H:Si:F film and realize the good property, the mixture of TMS, C_3F_8 and C_2H_2 gases was used for depositon (**Table. 1**), and the adhesion property and biocompatibility were evaluated.

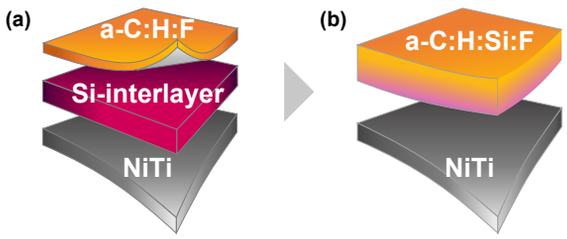

Fig. 1 Film structure images of (a) a-C:H:F with Si-interlayer and (b) a-C:H:Si:F

Table. 1 Deposition parameters of a-C:H:Si:F films

Sample name	bias (kV)	source gas flow late (sccm)		
		TMS	C_3F_8	C_2H_2
no-gradation	-1.5	6	50	0
F-gradation	-1.5	6	0→50	0
Si,F-gradation	-1.5	6→1	0→50	0
C_2H_2-doped	-1.5	6→0	0→50	0→3

Results and Discussion

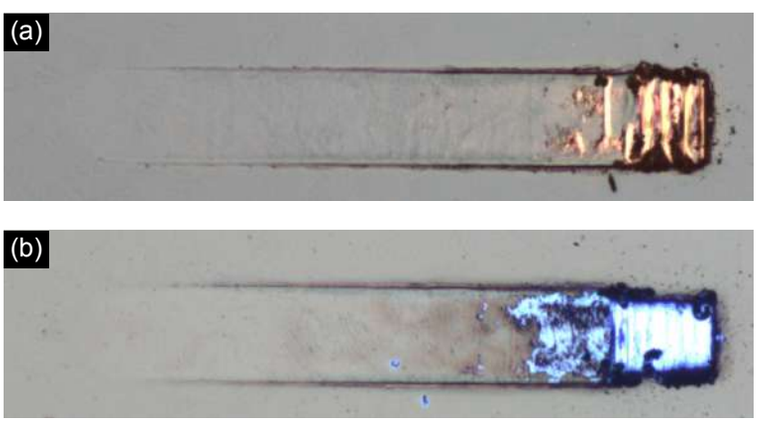

Fig. 2 The scratch traces of (a) C_2H_2-doped and (b) a-C:H:F with Si-interlayer

Evaluation of Adhesion

In this study, “no-gradation” was firstly deposited, but this showed low adhesion property. Thus, we newly developed a-C:H:Si:F films at a gas flow rate of gradually changed. In **Fig. 2**, the scratch traces of “C_2H_2-doped” , which is one of the gradation films, and a-C:H:F with Si-interlayer after the scrach test are shown. “C_2H_2-doped” exhibited higher adhesion property than a-C:H:F with Si-interlayer, because “C_2H_2-doped” was deposited in one process and had no low adhesion interface.

Evaluation of Biocompatibility

Platelet adhesion test and leukocyte adhesion test were conducted in order to evaluate biocompatibility of the “C_2H_2-doped” a-C:H:Si:F film and a-C:H:F with Si-interlayer. These two coatings were found to significantly reduce the number of adherent platelets (**Fig. 3**) and leokocytes (**Fig. 4**) compared with non-coated NiTi substrate, and exhibited the same number of them.

These results shows that C_2H_2-doped has the same biocompatibility as a-C:H:F, and means that these two films have similar chemical composition, bonding state and surface free energy.

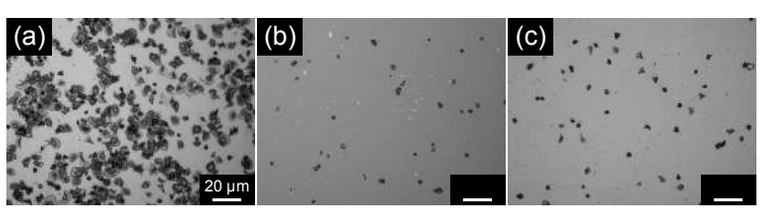

Fig. 3 Images of adherent platelets on each sample : (a) NiTi substrate, (b) C_2H_2-doped, (c) a-C:H:F with Si-interlayer

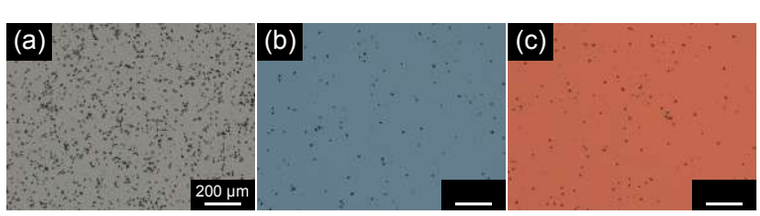

Fig. 4 Images of adherent leokocytes on each sample : (a) NiTi substrate, (b) C_2H_2-doped, (c) a-C:H:F with Si-interlayer