Fluorine-incorporated Hydrogen-free Amorphous Carbon Thin Film for Artificial Heart (Ventricular Assist Device)

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About our current study

We newly developed **Fluorine-incorporated Hydrogen-free Amorphous Carbon (a-C:F)** with filtered cathodic vacuum arc (FCVA) method, focused on excellent **blood compatibility** of fluorine-incorporated hydrogenated amorphous carbon (a-C:H:F) and excellent **mechanical properties** of hydrogen-free tetrahedral amorphous carbon (ta-C).

In this study, we evaluated the possible medical applications of a-C:F films for frictional parts of blood pump in **Ventricular Assist Device** (**Fig. 1**).

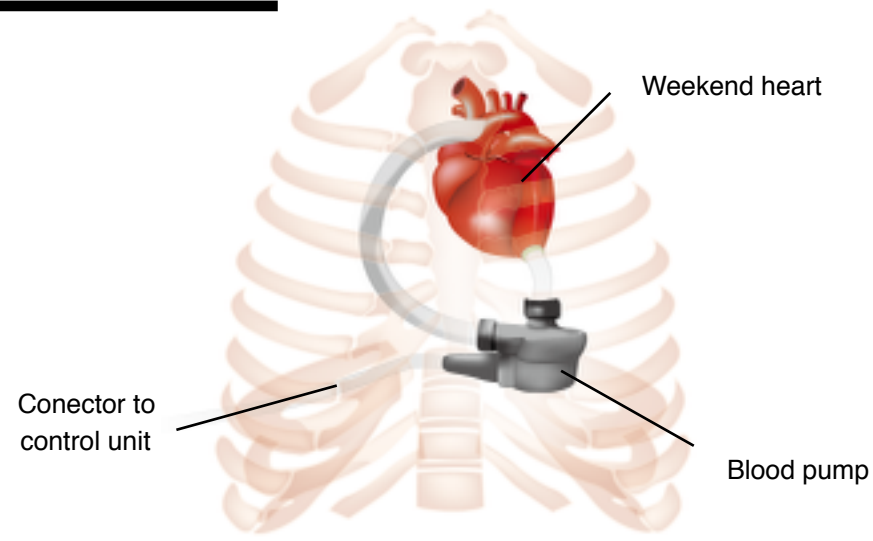

Fig. 1. Schematic image of Ventricular Assist Device (VAD).

Results and Discussion

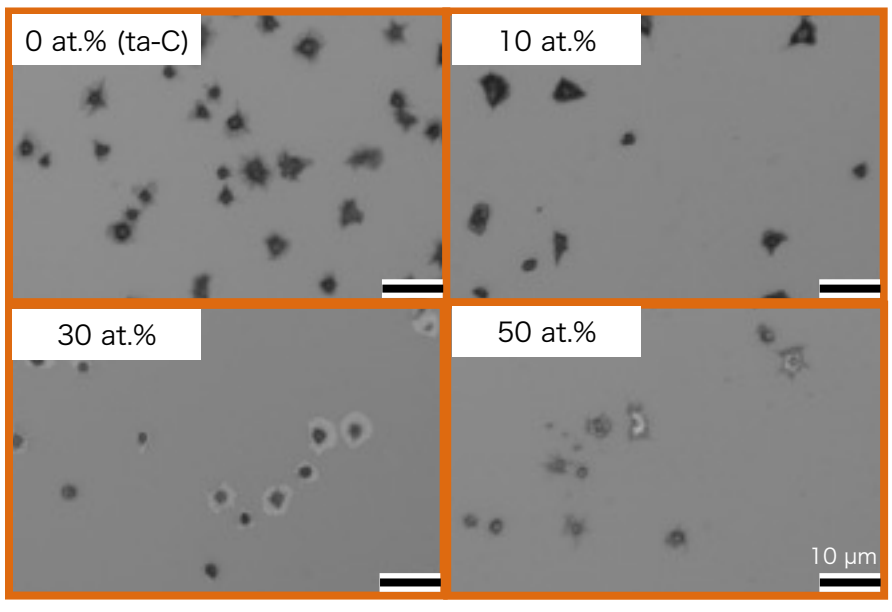

Fig. 2. Images of adherent platelets on each film.

Blood Compatibility Evaluation

By varying the pressure of C_3F_8 gas, we synthesized ta-C (0 at.% of fluorine) and a-C:F films which contains 10, 30, 50 at.% of fluorine. We evaluated blood compatibility of each sample by platelet adhesion test. The a-C:F films containing fluorine suppressed the number of adherent platelets and showed superior blood compatibility than the ta-C film (**Fig. 2**). This result means that C-F bonds in a-C:F film reduce the platelet adhesion.

Mechanical property Evaluation

In this study, we developed a-C:F film on frictional parts of blood pump and evaluate mechanical properties. In **Fig. 3**, images of a-C:H:F and a-C:F coated frictional parts after slide testing are shown. The a-C:H:F coated sample has many sliding marks and the greater part of a-C:H:F surface were worn out. On the other hands, there are no sliding marks on the surface of a-C:F coated sample. This result means that a-C:F film could show higher mechanical properties than a-C:H:F film because of sp^3 rich carbon structure.

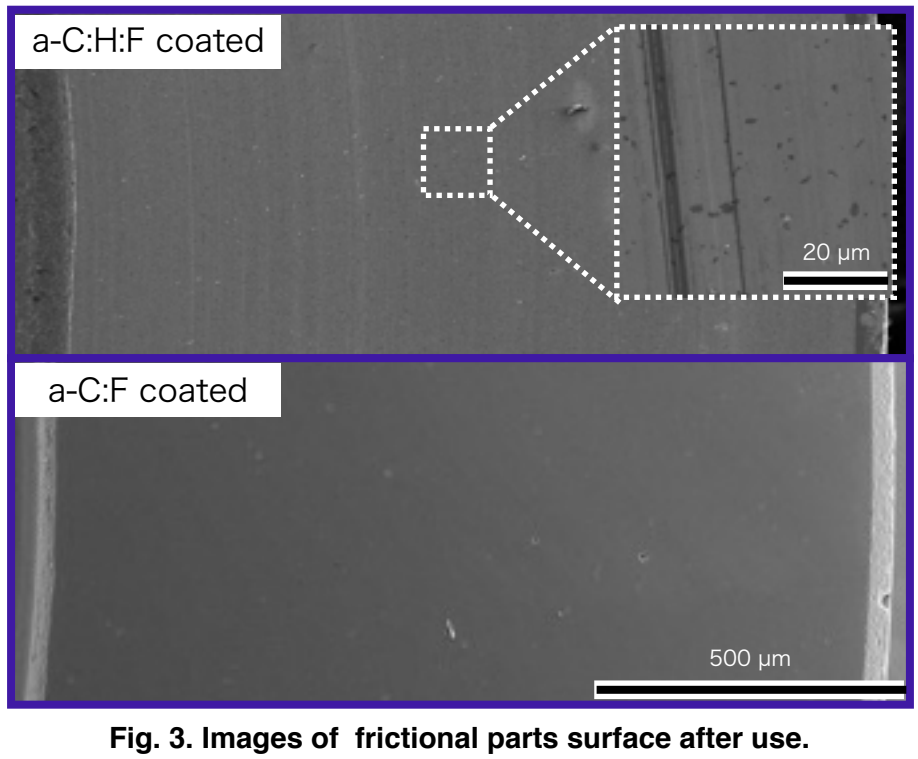

Fig. 3. Images of frictional parts surface after use.