論 文 の 内 容 の 要 旨

論文題目　Surface Treatment of Recycled Carbon Fiber by Plasma in Various Atmospheres
（様々な雰囲気下でのプラズマによるリサイクル炭素繊維の表面処理）

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Carbon fiber-reinforced plastics (CFRP) are among the most effective solutions. Because of their unique properties, CFRP have long allured scientists and industrial users. They can contribute to enhance stronger mechanical properties compared with steel [1, 2]. Specifically, CFRP have been largely applied not only to aircraft but also to develop energy-efficient automobiles. Because of their unique properties, CFRP are one of the best materials to increase the energy-to-weight efficiency of vehicles.

However, due to their high cost, long manufacturing times and other technical complications, CFRP has been had handicaps to apply for high-end usage [3]. To expand the volume of CFRP for general industrial usage, the recycling of carbon finer (CF) would be the most promising approach to cut down this main factor in the cost structure of manufacturing [4, 5].

Despite the advantages of recycled carbon fiber (RCF), it is innately different from freshly produced CF. Fresh CF has a polymeric-sized layer on the fiber to increase adhesion with the polymer matrix whereas RCF does not [6-8]. Thus, surface treatment to enhance the adhesion property of RCF is essential for idealized CFRP performance.

In this study, plasma surface treatments in Nitrogen ($N_{2)}$, Argon (Ar), CO_2 and dry air were used to change the surface adhesion property of RCF. In the plasma experiments in various atmospheres, the maximum plasma exposure time can be determined to be approximately 0.835 s. The oxygen percentage of plasma-treated samples in dry air increased, whereas that of the RCF in N_2, Ar. The significant result was that, even after very brief plasma treatment, this process can enhance the surface activity of RCF. This implies that plasma treatment introduces oxygenated functional groups on RCF, which may enhance adhesion between polymer and CF in CFRP.

On the other hand, plasma surface treatments with N_2, Ar, CO_2 and dry air, at least thirty valid data points were collected and then averaged for each plasma treatment condition. Unlike the dry air tendency, samples treated N_2 and Ar does not show any significant trend. The reason for this is that the deficiencies of oxygen containing functionalities on the N_2 and Ar treated

RCF. The results of the interfacial shear stress for all the samples in dry air exceeded those for the samples in others. Furthermore in the three point bending test, plasma treated specimen was improved approximately 17% higher than others. Flexural modulus also increased after treatment. And the mechanical properties of the treated specimen were close to those of fresh CF. These characteristics may help to overcome the drawbacks of recycled CF by restoring mechanical and chemical properties to levels approaching those of fresh CFRP.

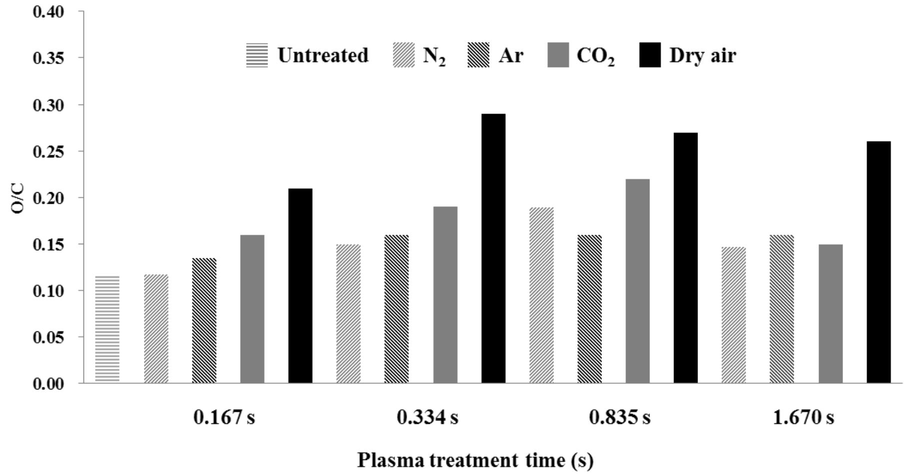

Figure 1. Comparison of the O/C level of RCF in various conditions

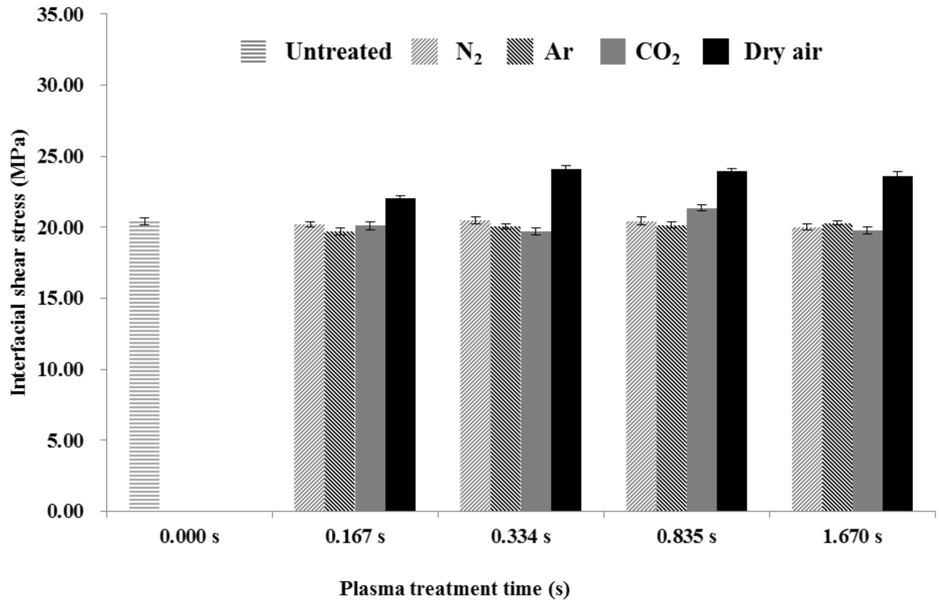

Figure 2. Comparison of the IFSS of RCF in various conditions

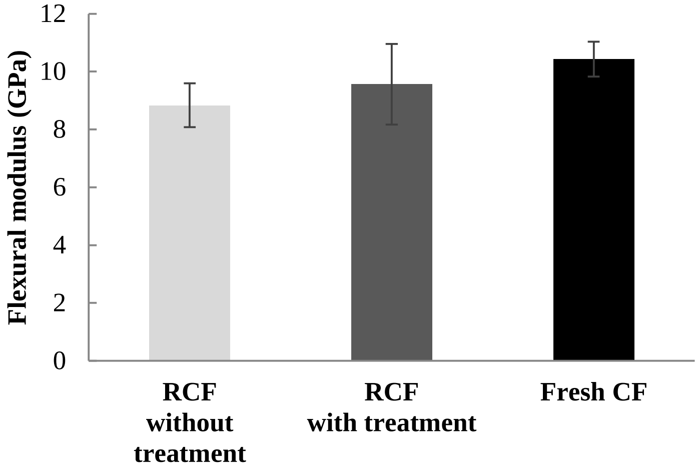

Figure 3. Flexural modulus of CFRP

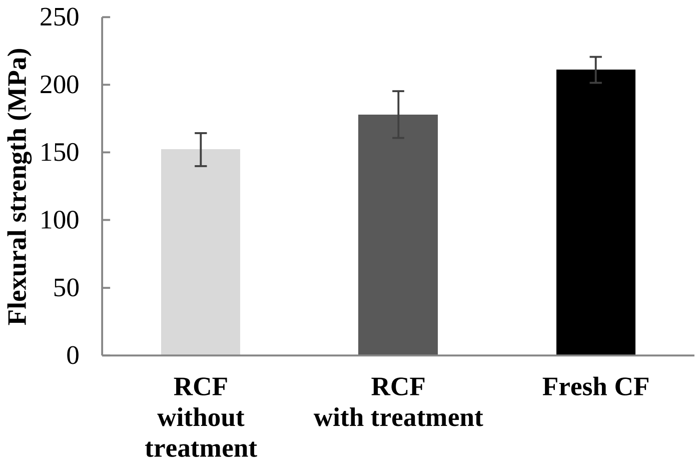

Figure 4. Flexural strength of CFRP

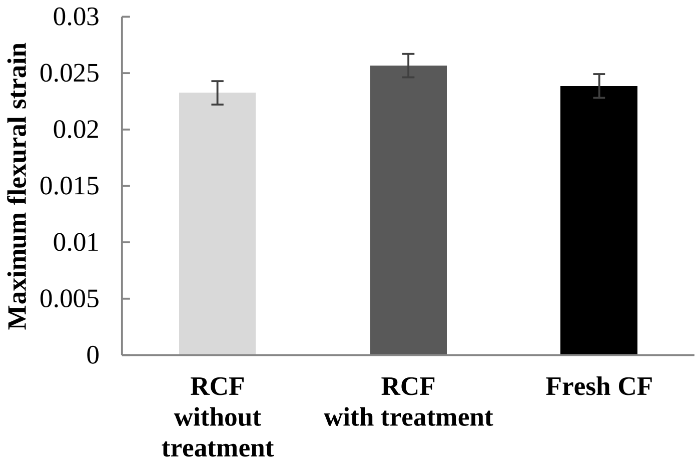

Figure 5. Maximum flexural strain of CFRP

Reference

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