

Motivation

Polytetrafluor ethylene (Teflon, PTFE) is widely used in the industrial field in modern society due to its many excellent properties. However, sometimes, the adhesion of PTFE surface needs to be utilized too. The main objective of this work is to improve the adhesion of PTFE tubes by diffuse coplanar surface barrier discharge (DCSBD). The PTFE sheets and tubes were treated by the low-temperature, non-equilibrium plasma generated in ambient air, argon, and the mixture of H₂/N₂ and analyzed to reveal the plasma-induced changes of surface chemistry. The results show that the adhesion of the PTFE tubes can be effectively improved by DCSBD plasma even after short treatment times (1-10 s). The mixture of H₂/N₂ plasma was found to be the most effective gas mixture for adhesion improvement of PTFE tubes. The results of plasma-treated PTFE tubes with improved adhesion can be utilized e.g. in bio-medical products and PTFE-coated solar tubes.

Results

Figure 1. The Schematic diagram of DCSBD unit and the color of surface DCSBD plasma generated in ambient air, Argon and the mixture of H₂/N₂.

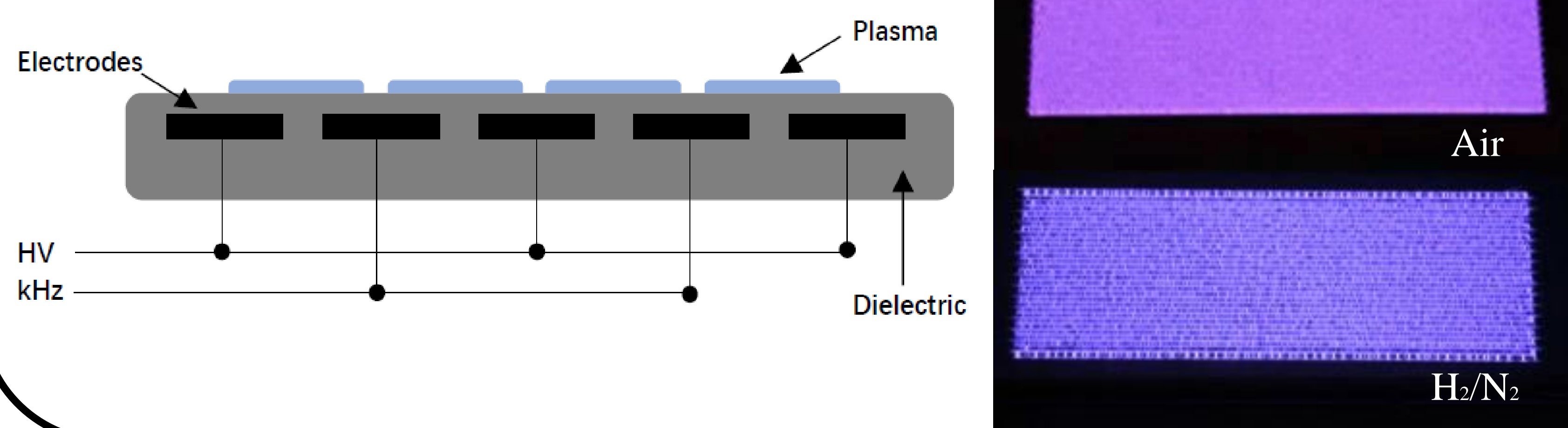


Figure 2. Configuration of PTFE adhesion test and adhesion test with different exposure time.

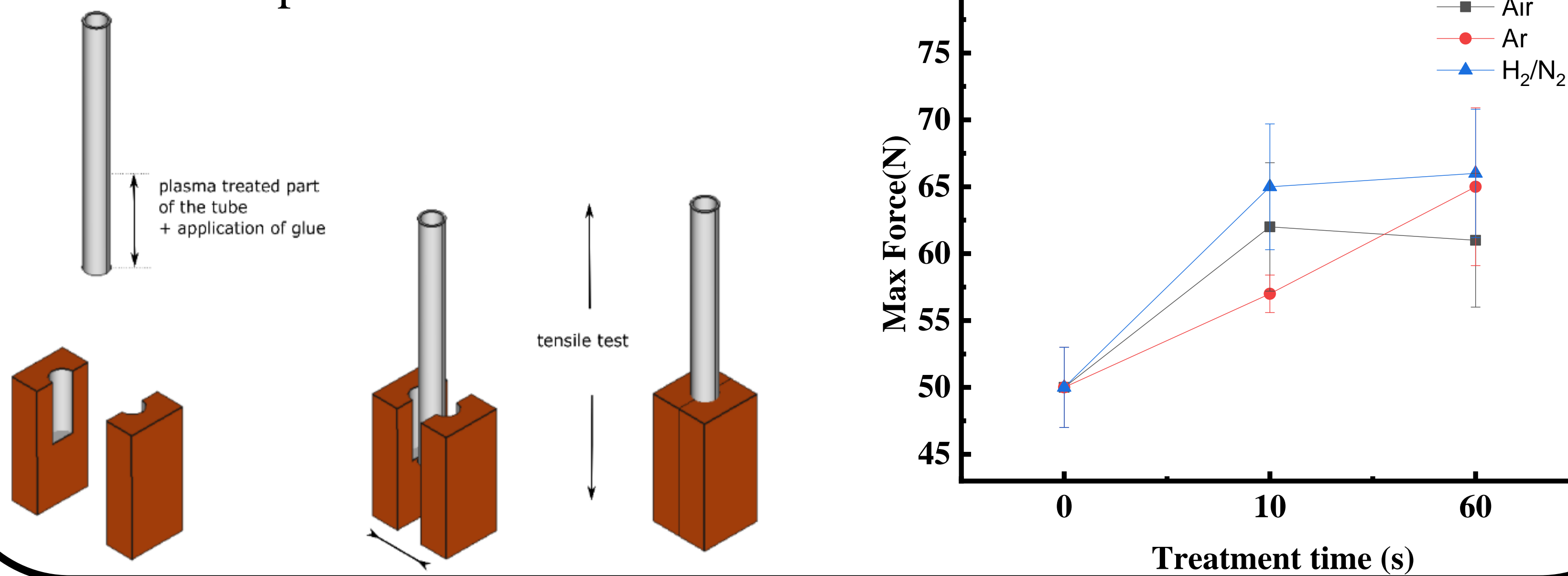


Figure 3. Variation of the water contact angle and surface free energy on the PTFE surface with different exposure time.

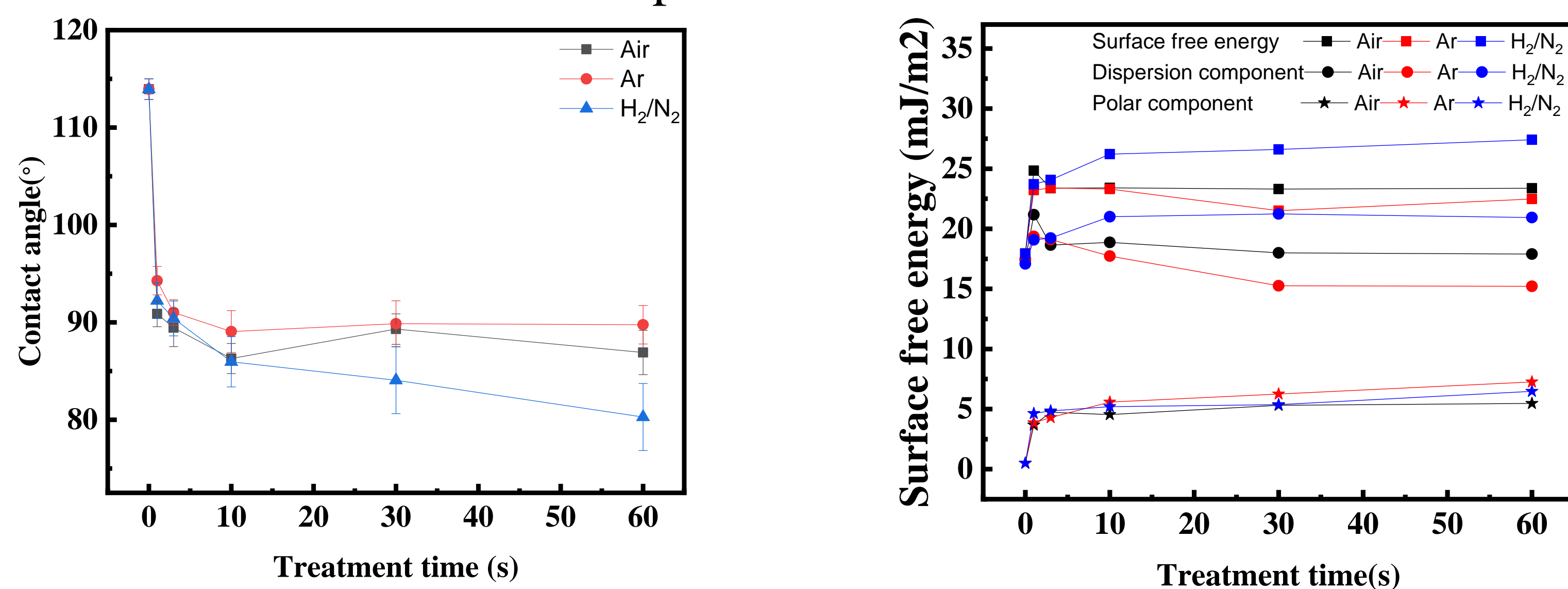


Figure 4. Change in atomic concentration of PTFE surface with different plasma exposure time.

Time	H ₂ /N ₂			
	Atomic Content (%)			
	F	C	O	N
0s	68.0	31.4	0.7	
1s	67.7	31.5	0.9	
3s	66.2	32.2	1.2	0.4
10s	66.1	32.3	1.1	0.5
30s	62.3	35.9	1.5	0.3
60s	65.3	32.6	1.5	0.6

Figure 5. The evolution of F/C and O/C ratio on plasma-treated PTFE surface.

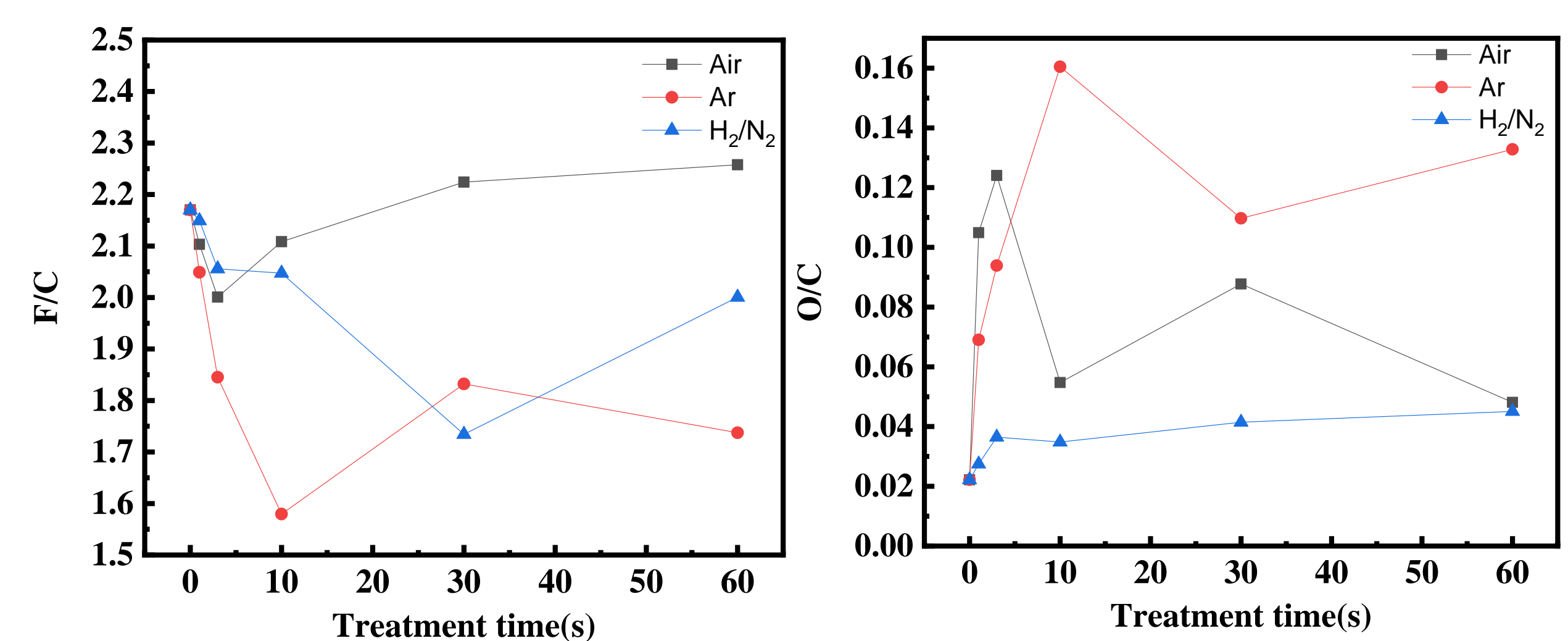
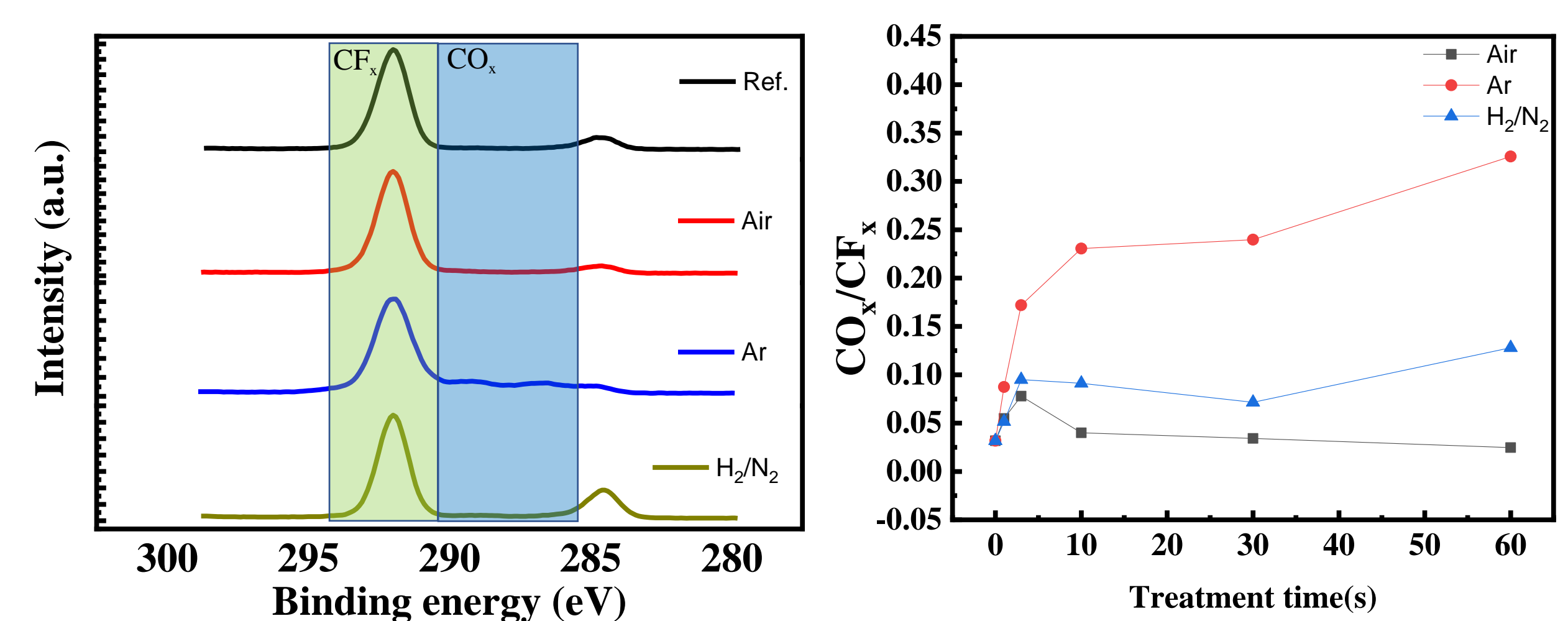


Figure 6. The C 1s XPS spectra and evolution of CO_x/CF_x ratio on plasma-treated PTFE surface.



Conclusion

The PTFE tubes were treated by the DCSBD plasma generated in ambient air, argon and the mixture of H₂/N₂. We have observed that the adhesion of the PTFE tubes can be effectively improved by the DCSBD plasma. The reason why plasma enhanced the adhesion of PTFE tubes was revealed. PTFE treated by DCSBD plasma results in an increase of oxygen and carbon concentration, decrease of fluorine concentration and changes in presence of polar functional groups. In this work, we provide a friendly way to quickly improve the adhesion of PTFE tubes, it will further expand the application of PTFE tubes, especially for bio-medical products and PTFE-coated solar tubes.