Electronic Supplementary Material (ESI) for Nanoscale Advances.

Interfacial Interactions and Enhancing Mechanism of Metallic Coatings Molecular-Gluing on Polymer Surfaces

*Dexin Chen [1,4] *, Zhixin Kang [2] *, Hidetoshi Hirahara [3], Wei Li [1,4]*

[1] Institute of Advanced Wear & Corrosion Resistant and Functional Materials, Jinan University, 601 Huangpu Avenue West, Guangzhou 510632, China

[2] Guangdong Key Laboratory for Advanced Metallic Materials Processing, School of Mechanical and Automotive Engineering, South China University of Technology, 381 Wushan, Guangzhou 510640, China

[3] Faculty of Science and Engineering, Iwate University, 4-3-5 Ueda, Morioka 020-8551, Japan

[4] Shaoguan Research Institute of Jinan University, Wujiang District, Shaoguan 512027, China

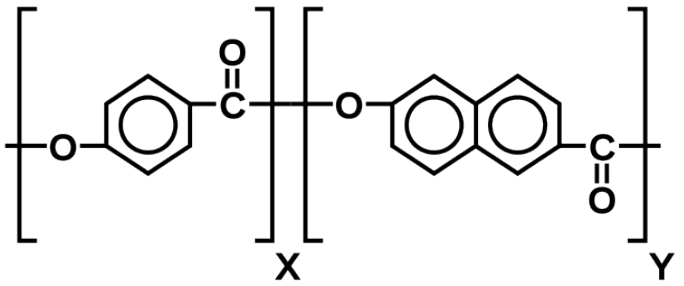

Figure S1 Molecular structure of Vectran Liquid Crystal Polymer

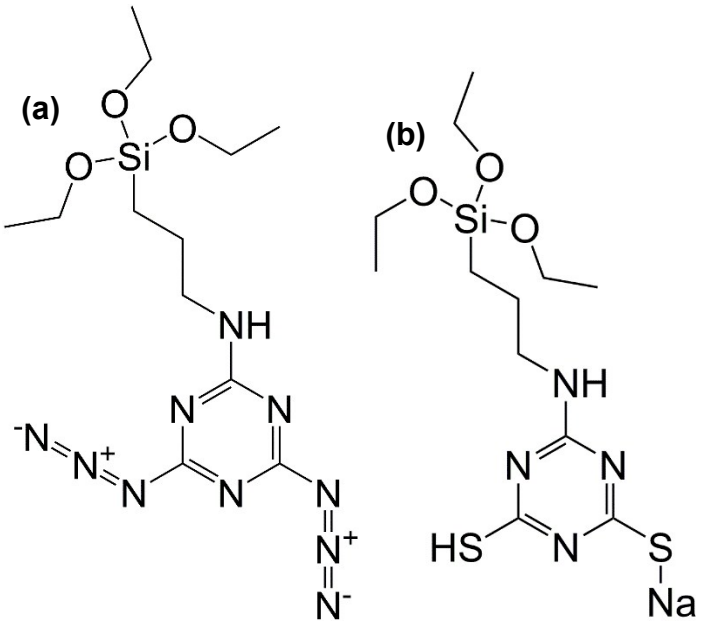

Figure S2 Molecular structure of (a) 6-(3-triethoxysilylpropylamino)- 1,3,5-triazine-2,4-azide (pTES) and (b) 6-(3-triethoxysilylpropylamino)-1,3,5-triazine-2,4- dithiol monosodium (nTES).

Table S1 Element amounts from EDS in Figure 6(d-f).

Element (wt.%)	C	N	O	Al	Si	S	Ag
Point 1	8.72	-	0.86	2.48	1.92	-	86.02
Point 2	61.27	8.40	8.04	1.44	4.66	0.73	15.46
Point 3	80.05	-	16.20	1.78	1.98	-	-

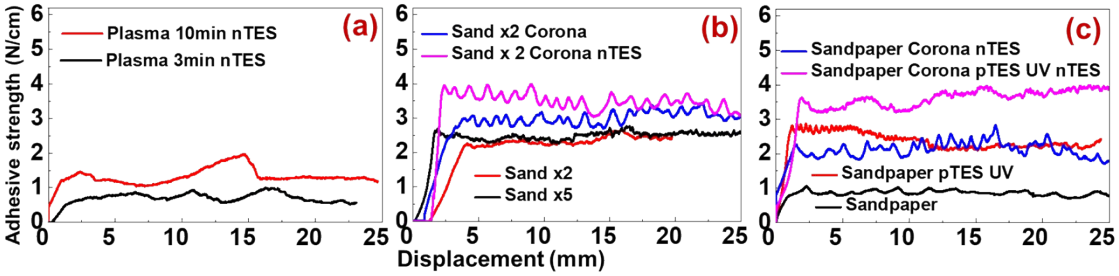

Figure S3 Typical adhesive strength of metal coatings on LCP substrate by different surface treatments with 90° peel test: (a) plasma, (b) sand blasting and (c) sandpaper.

LCP substrates were treated with low pressure plasma equipment for 3 or 10 min (PICO Powder Treatment Diener Electronic, pressure of 0.6 ~ 0.8 mbar, Ar gas with rate of 20 cm^3/min). After nTES assembling and metallization, the metallic coated LCP were applied for 90° peel test, and typical adhesive strength is about 0.5 and 1 N/cm, as shown in Figure S4a. If the pre-treatment is sand blasting (Cycle Junior Ⅱ, Daiei Dental Product Co. Ltd., Al_2O_3 with size of 53 ~ 45 μm) for 2 or 5 times, the adhesive strength can be up to 3.5 N/cm (Figure S4b). By using sandpaper (#2000), the adhesive strength can be also up to 3.5 N/cm (Figure S4c).

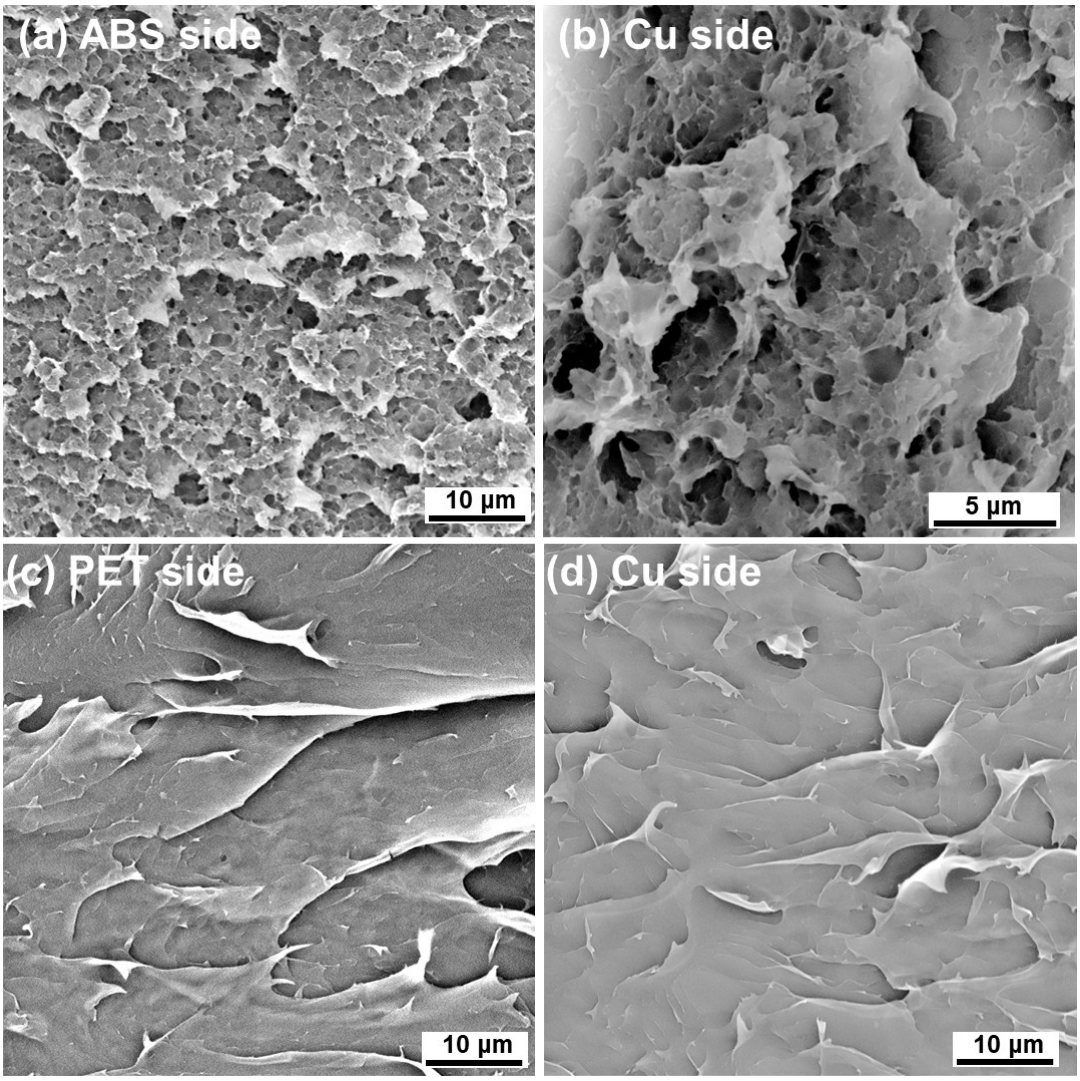

Figure S5 SEM images after peel off: metallic coatings on (a-b) ABS and (c-d) PET surfaces with p-nTES treatment.

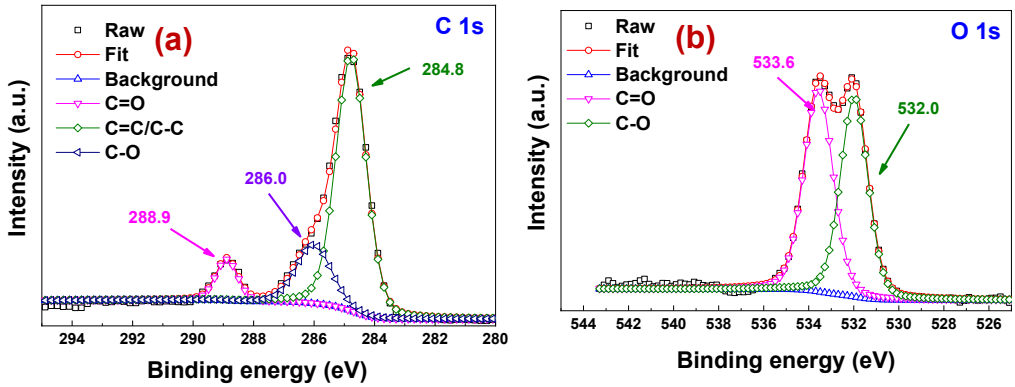

Figure S5 XPS high resolution (a) C1s and (b) O1s of topmost surface of LCP blank.

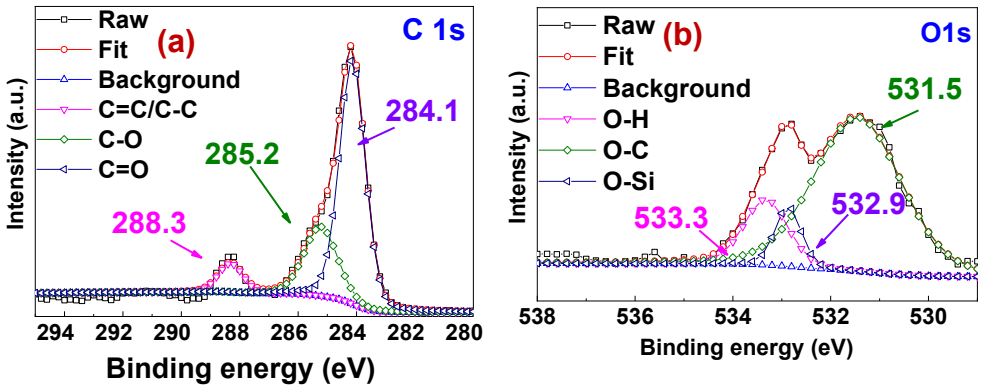

Figure S6 XPS high resolution (a) C1s, (b) O1s and of topmost surface of corona treated LCP surfaces.

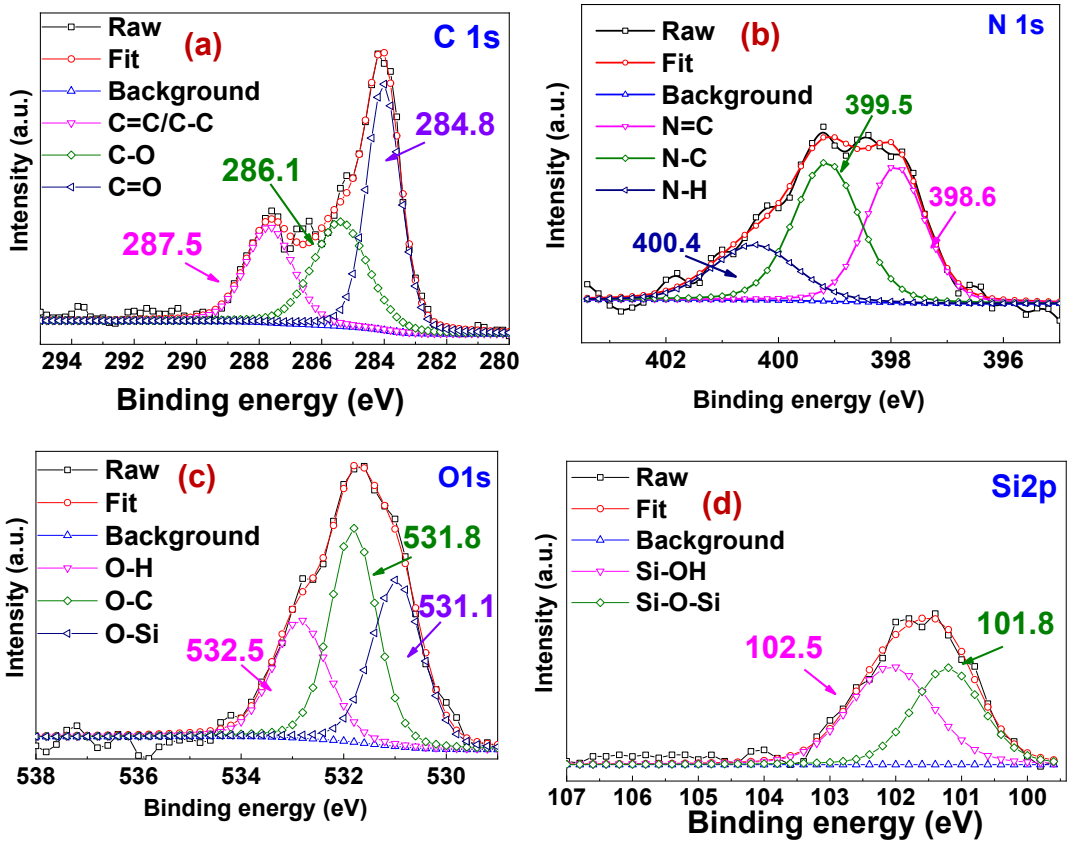

Figure S7 XPS high resolution (a) C1s, (b) N 1s, (c) O1s and (d) Si2p of topmost surface of pTES treated LCP surfaces.

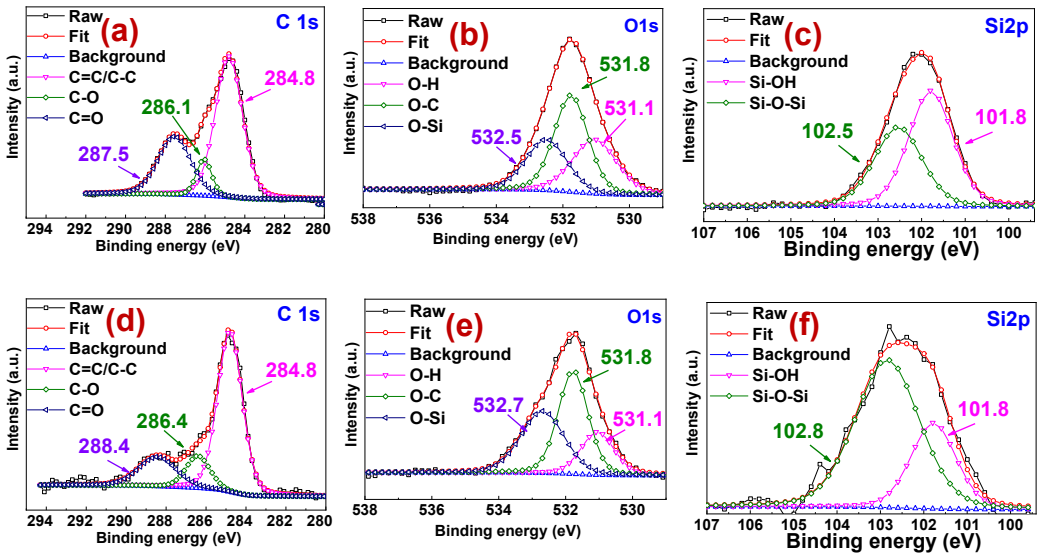

Figure S8 XPS high resolution (a, d) C1s, (b, e) O1s and (c, f) Si2p spectra of 0.1 wt.% nTES self-assembled on (a-c) corona-activated and (d-f) pTES-grafted LCP surfaces.

For the C-nTES surfaces, there are also three peaks of 287.5, 286.1 and 284.8 eV in C 1s spectra, which are corresponding to C=O, C-O and C=C/C-C bonds, respectively. O 1s spectra were fitted into three peaks of O-Si (532.5 eV), O-C (531.8 eV) and O-H (531.1 eV). The Si 2p spectrum exhibits two contributions, located at respectively 102.5 and 101.8 eV, which can be assigned to Si-O-Si and Si-OH. For the p-nTES surfaces, the fitting strategies are similar with those of the C-nTES surfaces, except some bonds are blue-shifted, including C=O in C 1s, O-Si in O 1s and Si-O-Si in Si 2p.

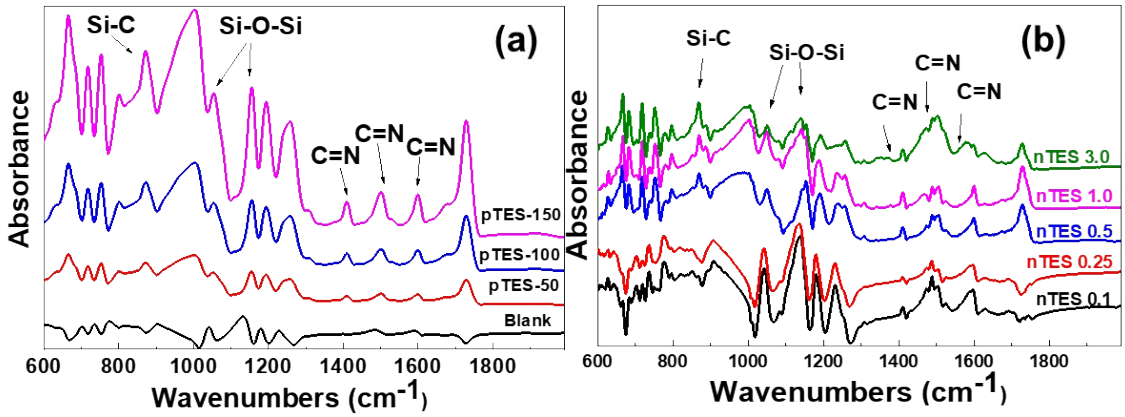

Figure S9 IR spectra with different (a) UV radiation and (b) nTES dosages of the treated LCP.

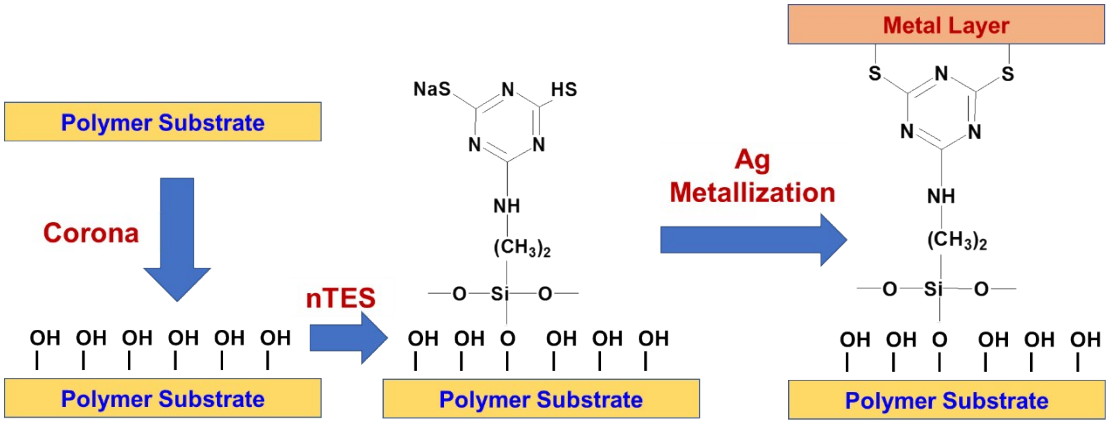

Figure S10 Ideal flow diagram of preparing molecular bonding between polymer substrate and metal layer for C-nTES.

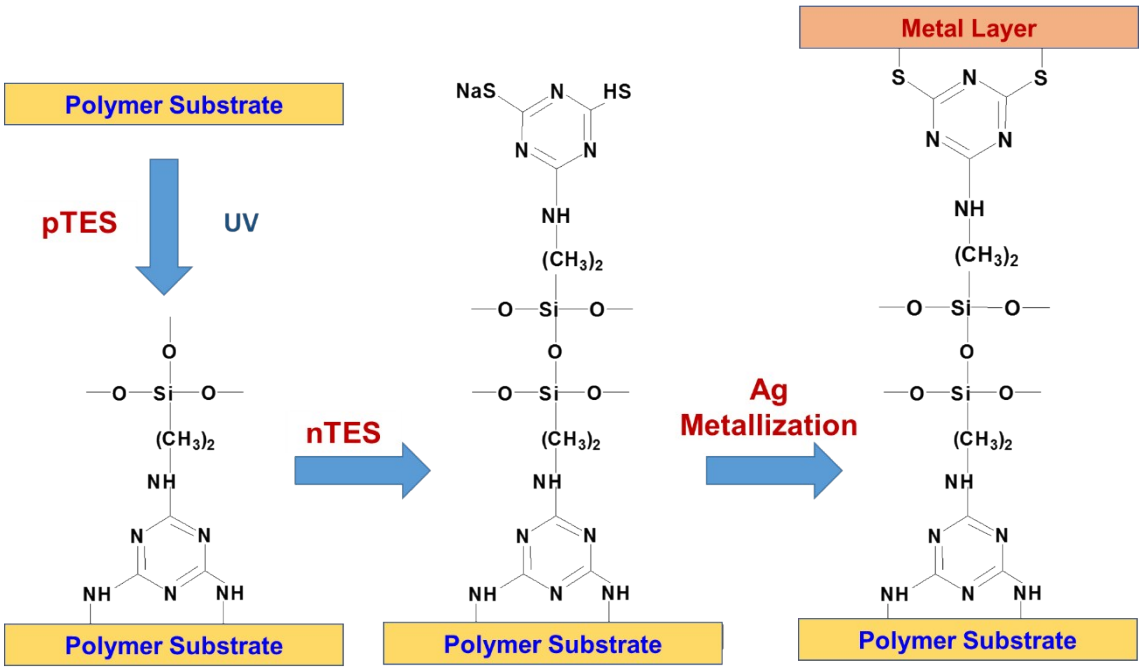

Figure S11 Ideal flow diagram of preparing molecular bonding between polymer substrate and metal layer for p-nTES.