Low Cost and Large-area Fabrication of Self-Cleaning coating on polymeric surface Based on Electroless-Plating-Like Solution Deposition Approach

Supporting information

By Liangzhuan Wu, Yuan Yu, Jinfang Zhi*

Supporting information S1: The swelling kinetics of PET film in aniline

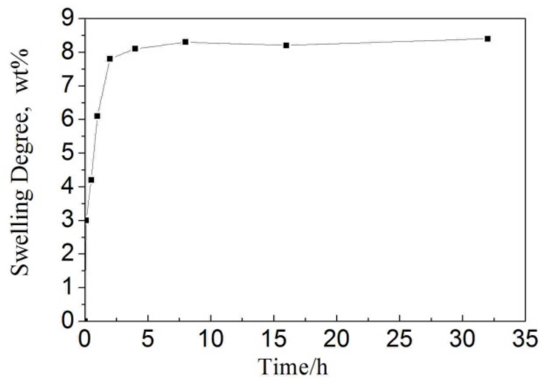

Fig. S1. Swelling kinetic curves of the PET films in aniline.

It is well-known that aniline polymerization in a polymer matrix may be achieved only under the matrix film swelling condition in the monomer solution. So, to determine the time necessary to get the maximum swelling value the investigations of the swelling kinetics of PET film in aniline were performed. As we can see from Fig. 1, the swelling process of the PET film is slow, it takes almost 2h to reach the plateau value of 8 wt.% of aniline, and according to the literature report, this can be explained by the PET nature of being crystalline polymer.

As to our experiment procedure, the swelling process of PET was carried out in a 2 L beaker, 20*40 cm PET film (10.98g) was immersed in the 1.5 L mixed organic solvent of Aniline and EtOH in the above flask for a 2h, allowing nearly 0.87g aniline monomer was absorbed onto the PET surface.

Supporting information S2: the effect of swelling ratio of aniline monomer to the EPLSD process

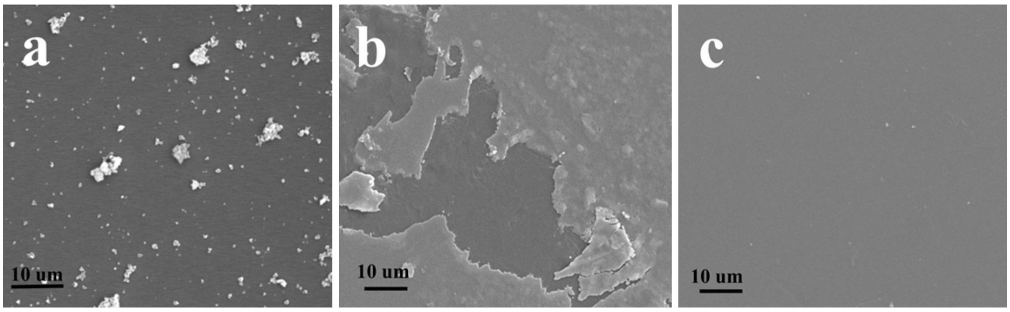

Fig. 2. SEM images of the flexible film samples of Flexible PET films coated with TiO_2-SiO_2 obtained from EPLSD processes, and the PET films were pretreated with Anliline for (a) 30min, (b) 60min, and (c) 120min.

The effect of swelling ratio of aniline monomer to the EPLSD process was identified by varying the swelling time of the as purchased PET film in the Aniline solution, and the as prepared TiO_2-SiO_2 coated PET film was characterized by SEM observation. As was shown in Fig. 2a, only separated particles can be observed on the surface of the as prepared TiO_2-SiO_2 coated PET film with a 30 min swelling time. Accomanied with a 60 min swelling time, according to the result shown in Fig. 3b, discontinuous film can be observed on the PET surface. After a 2h pretreatment of the PET film, which means a swelling plateau value of 8 wt.% of aniline, a continuous and smooth coating on the PET film can be observed in Fig. 2c.

Supporting information S3: the structure of nanocomposite SiO_2/TiO_2

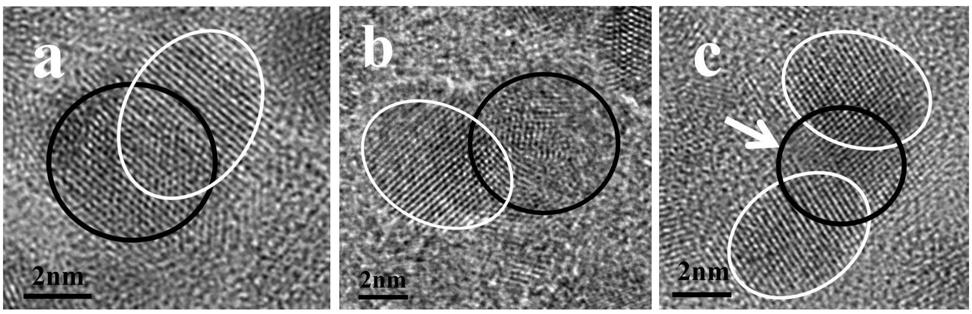

Figure S3. TEM images of the as prepared P-Si composite solution, the insert white circult represent the TiO_2 nanoparticles and the insert black circult represent SiO_2 nanoparticles.

It is clear that all of the SiO_2 nanoparticles observed in the Fig. 2 were covered by TiO_2 nanoparticles, but their structures were random, which means the structure of nanocomposite SiO_2/TiO_2 was random disordered structure.

Supporting information S4: FTIR spectrum taken from the as prepared P-Si

naosol.

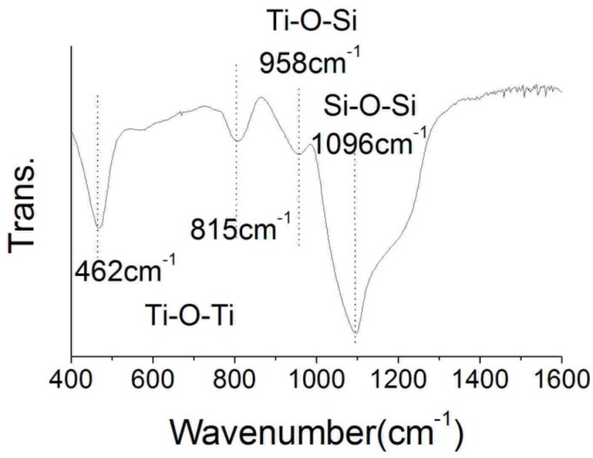

Figure S4: FTIR spectrum taken from the as prepared P-Si naosol.

The FT-IR spectra of the as prepared samples were shown in Fig. S4. The characteristic peaks attributed to the TiO_2 (462 cm^{-1} and 815 cm^{-1}) and SiO_2 (1096 cm^{-1}) respectively can be identified clearly, and this agree with the TEM and XRD result that the nano particles was a nanocomposite of TiO_2-SiO_2. Moreover, a new band at 958 cm^{-1} can be observed, as reported in the literature, which can be assigned to the stretching vibration Ti-O-Si. And this suguessted that, during the EPLSD process, a chemical reaction between PTC and SiO_2 nanoparticle happened and a Ti-O-Si bond was formed, which was responsible for the generation of the TiO_2-SiO_2 nanocomposite.

Supporting information S5: EDS spectra of the flexible PET films coated with PSi nanosol

Element	Weight %	Atomic %
C K	24.59	44.49
O K	34.42	46.77
Si K	3.82	2.96
Ti K	4.88	2.22
Au M	32.29	3.56
Totals	100.00	

Figure S5. EDS spectra of the flexible PET films coated with PSi nanosol characterized by EDS.

The EDS (see supporting information S4) spectra analysis suggested that the composition of these nanoparticles which formed on the surface of the PET films mainly contains Ti, Si. C and O elements, and an atomic ratio of C (44.69%): Ti (2.96%): Si (2.22%) can be identified.

Supporting information S6: EDX line scan of the flexible TiO_2-SiO_2 films obtained from EPLSD processes throughout the film from the surface to the bottom

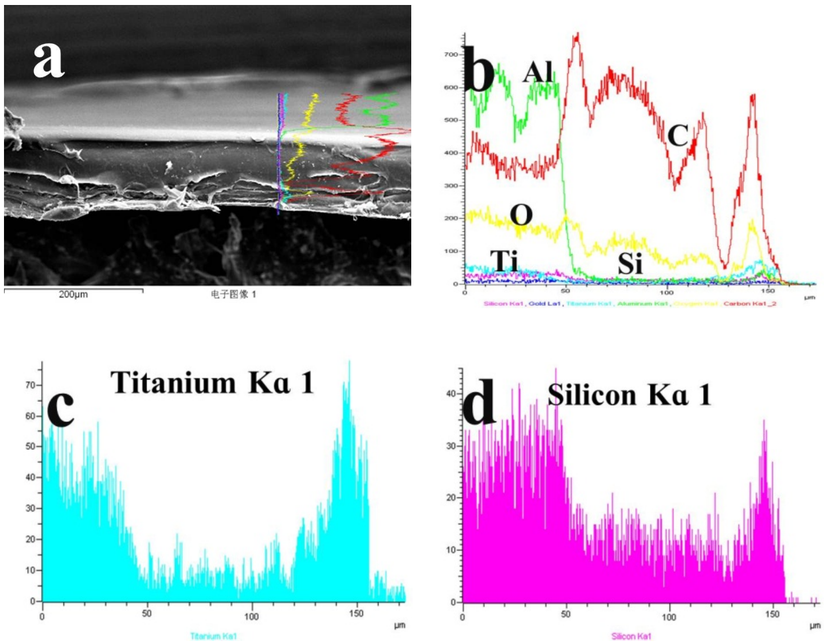

Fig.1 The cross-section image of flexible TiO_2-SiO_2 films obtained from EPLSD processes and its EDX line scan result throughout the film from the surface to the bottom. (a) SEM image, (b) all element EDX line scan result, (c) titanium EDX line scan and (d) silincon EDX line scan result of the flexible TiO_2-SiO_2 films, respectively.

In order to understand the elemental composition profile throughout the film from the surface to the bottom, an EDX line scan throughout the film from the surface to the bottom was performed. The cross-section image of the as prepared flexible TiO_2-SiO_2 films was shown in Fig. 1a, and its result was shown in Fig. 1b, revealing the existence of element C, Ti and Si (Au comes from the sputtering process and Al comes from the testing substrate). Different from the average distribution of elements C from the bottom to the surface, as was shown in Fig. 1c and id, a saddle-shaped distribution of the element Ti and Si can be observed, suggesting that the element Ti and Si were mainly centralized on the surface of the PET film.