Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information for

Preparation of mechanically stable triple-layer interference broadband antireflective coatings with self-cleaning property by sol-gel technique

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Study of films' chemical composition and degree of condensation by FT-IR spectral analysis

As shown in figure S1, the SiO_2 film and the SiO_2-TiO_2 composite film have two absorption bands at 1060 and 791 cm^{-1} that are typical of silica from the sol–gel process. These bands are attributed to the Si–O–Si asymmetric stretching and symmetric stretching absorption bands, respectively. The two samples also exhibited an absorption band near 953 cm^{-1}, which is assigned to Si–OH or Si-O-C groups. The band at 1164 cm^{-1} corresponding to the C-H bending vibration, indicates the presence of $-OC_2H_5$ groups. The broad bands between 400 and 800 cm^{-1} associating with Ti–O–Ti network are distinct in TiO_2 film. The O-H stretching vibration absorption band at 3400 cm^{-1} is observed in the spectra of all samples. This peak is attributed to –OH and the adsorbed H_2O. Besides, an O-H bending vibration of water molecule is also observed at 1630 cm^{-1} as KBr salt tablets are easy to absorb water.

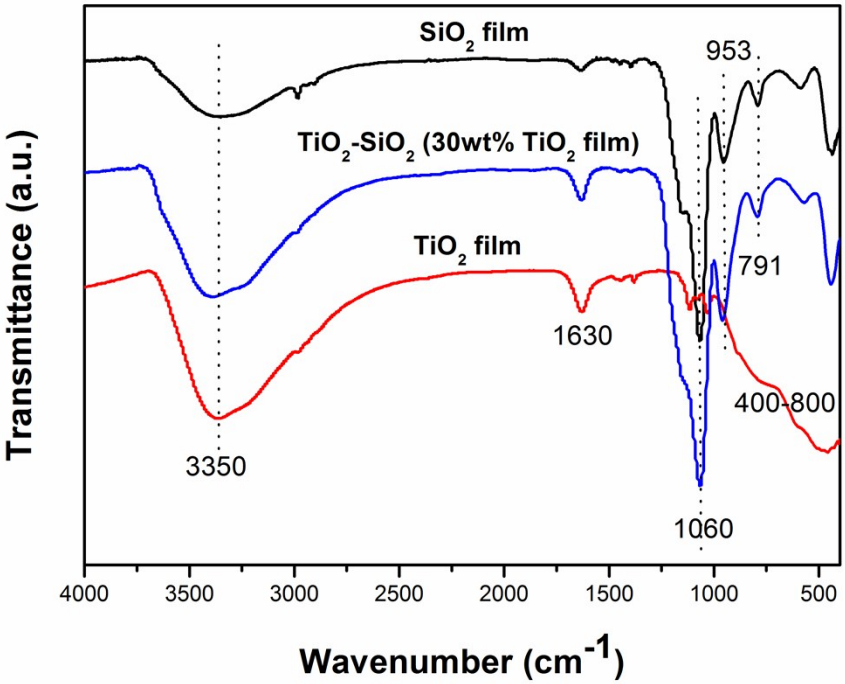

Figure S1 FTIR spectra of SiO_2 film, SiO_2-TiO_2 composite film and TiO_2 film in the regime of 4000-400 cm^{-1}.

The condensation process of SiO_2 is the Si-OH or Si-OR groups to form siloxane groups (Si-O-Si). Ratio of integrated intensity of Si-O-Si to Si-OH peaks at positions 1060 cm^{-1} and 953 cm^{-1} can indicate the degree of condensation[1].

Figure S2 shows the Gaussian peak fitting of the FTIR spectra for acid-catalyzed SiO_2 film; individual peaks were resolved for relative intensity calculation. After resolving individual peaks, the area under the peak was calculated toward their integrated intensity. Ratio of integrated intensity of Si-O-Si to Si-OH peaks at positions 1060 cm^{-1} and 953 cm^{-1} was calculated. Calculated ratio was found to be 2.9. In the case of base-catalyzed silica, the ratio is larger (4.9, figure S3). The relative increase in the peak integrated intensity ratio of base-catalyzed SiO_2 film shows an increase in formation of Si-O-Si. In other words, the degree of condensation for acid-catalyzed SiO_2 film is much lower than

base-catalyzed SiO_2 film.

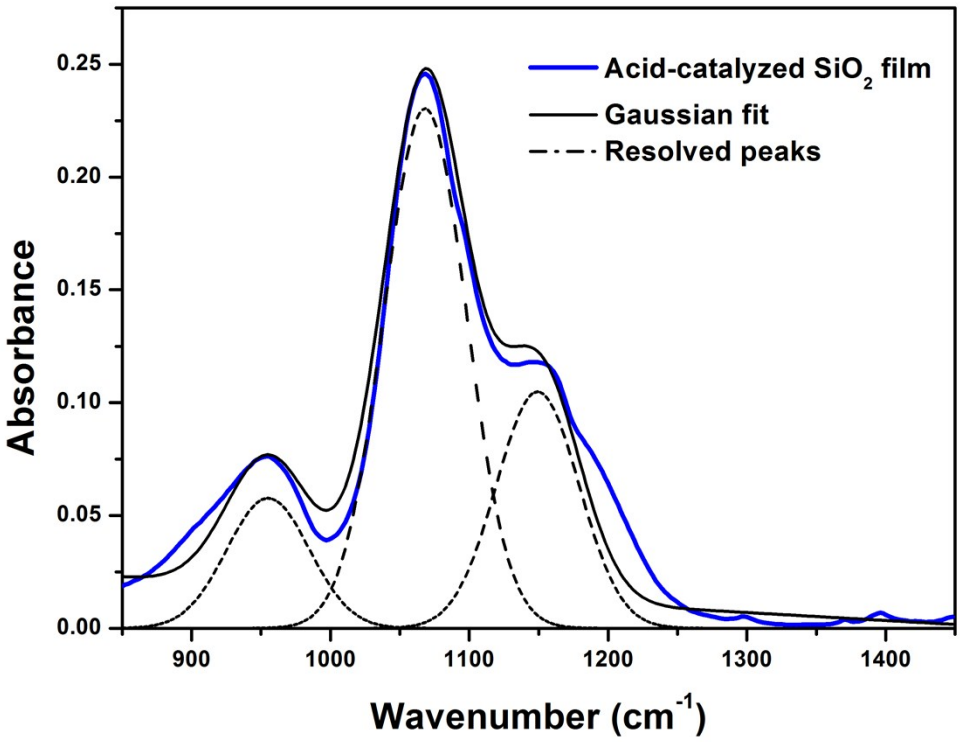

Figure S2. Gaussian peak fitting of the FTIR spectra for acid-catalyzed SiO_2 coating; individual peaks were resolved.

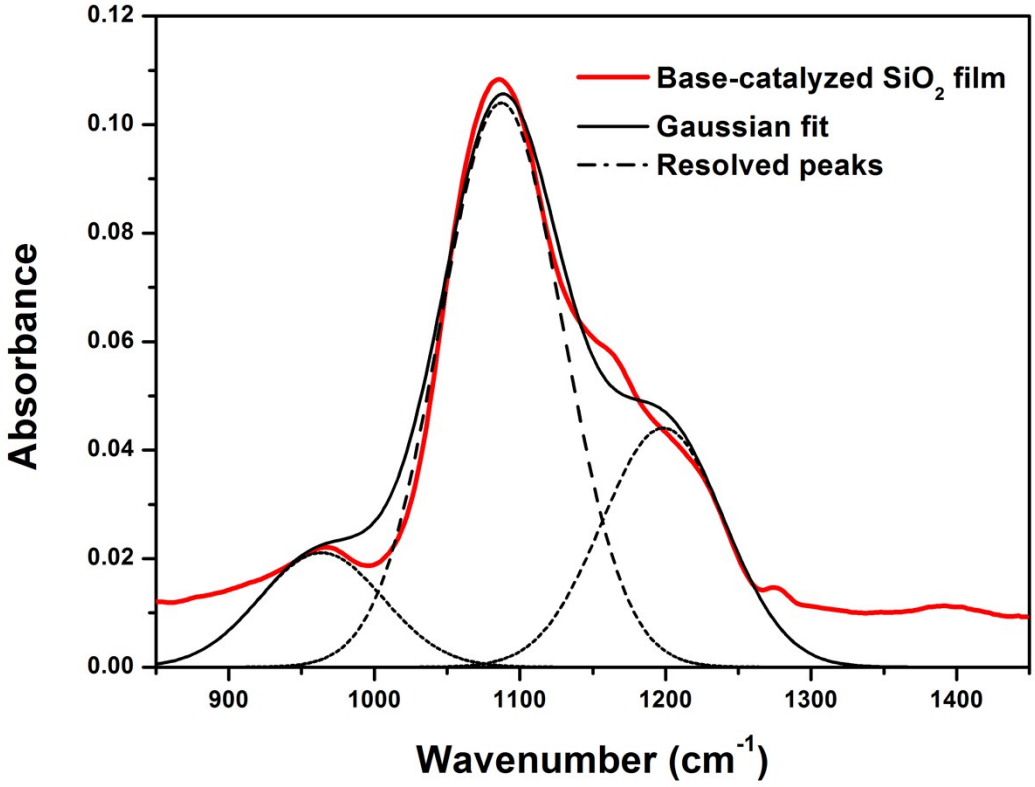

Figure S3. Gaussian peak fitting of the FTIR spectra for base-catalyzed SiO_2 coating; individual peaks were resolved.

Particle size and its distribution of acid- and base-catalyzed SiO_2 and TiO_2 sols

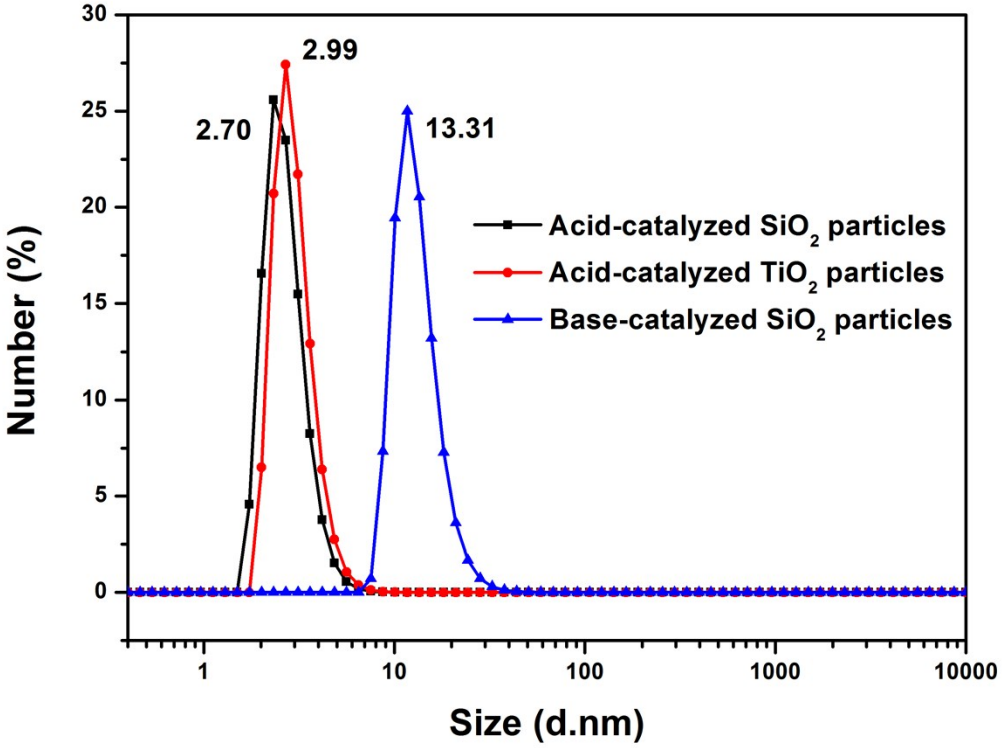

Figure S4. Particle size and its distribution of acid-catalyzed SiO_2 sol, base-catalyzed SiO_2 sol and TiO_2 sol

Their PdI (polydispersity index) values are 0.38, 0.37 and 0.26 for acid-catalyzed SiO_2, TiO_2 and base-catalyzed SiO_2 samples, respectively. According to the Malvern specification, samples with PdI ≈ 0.2 are considered to be monodisperse. These results indicate that these sols are all monodisperse.

Study of the crystal structure of TiO_2 by XRD

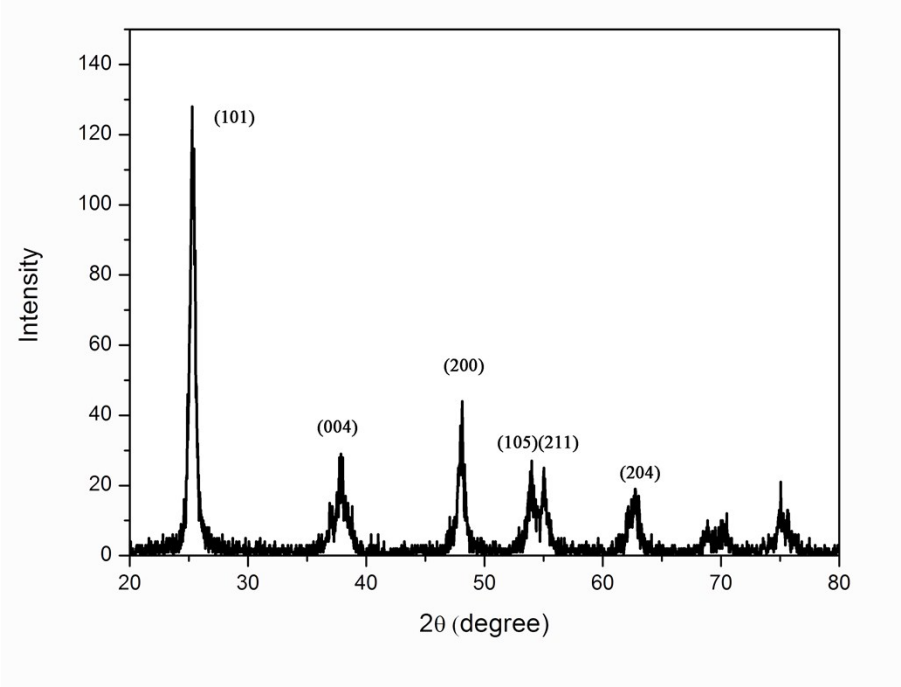

Figure S5. XRD patterns of TiO_2 powder after calcination for 2h at 400 °C.

Anti-fogging property of the triple-layer film

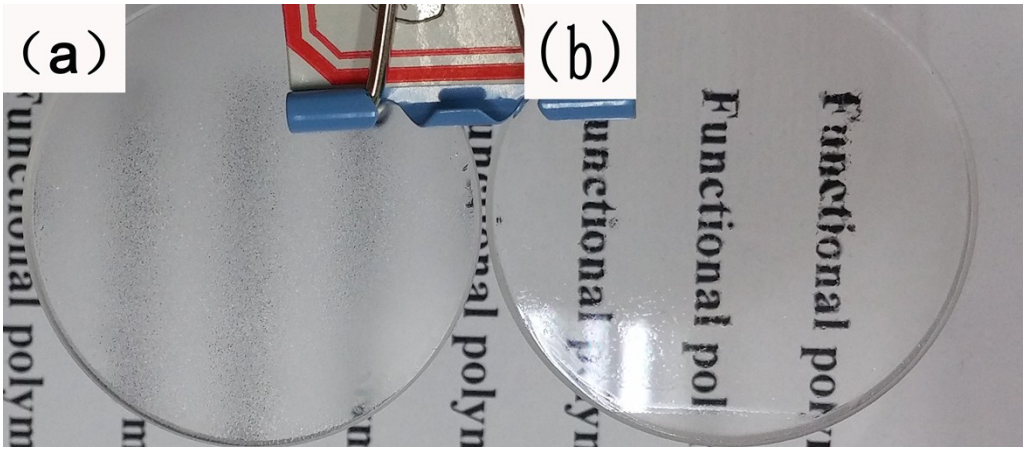

Figure S6. Digital image exhibiting antifogging properties of (a) uncoated and (b) the triple-layer film coated glass substrates.

1. A. Vincent, S. Babu, E. Brinley, A. Karakoti, S. Deshpande and S. Seal, *J Phys Chem C*, 2007, **111**, 8291-8298.