Supporting Information

A Highly Durable Silica/Polyimide Superhydrophobic Nanocomposite Film with Excellent Thermal Stability and Abrasion Resistant Performances

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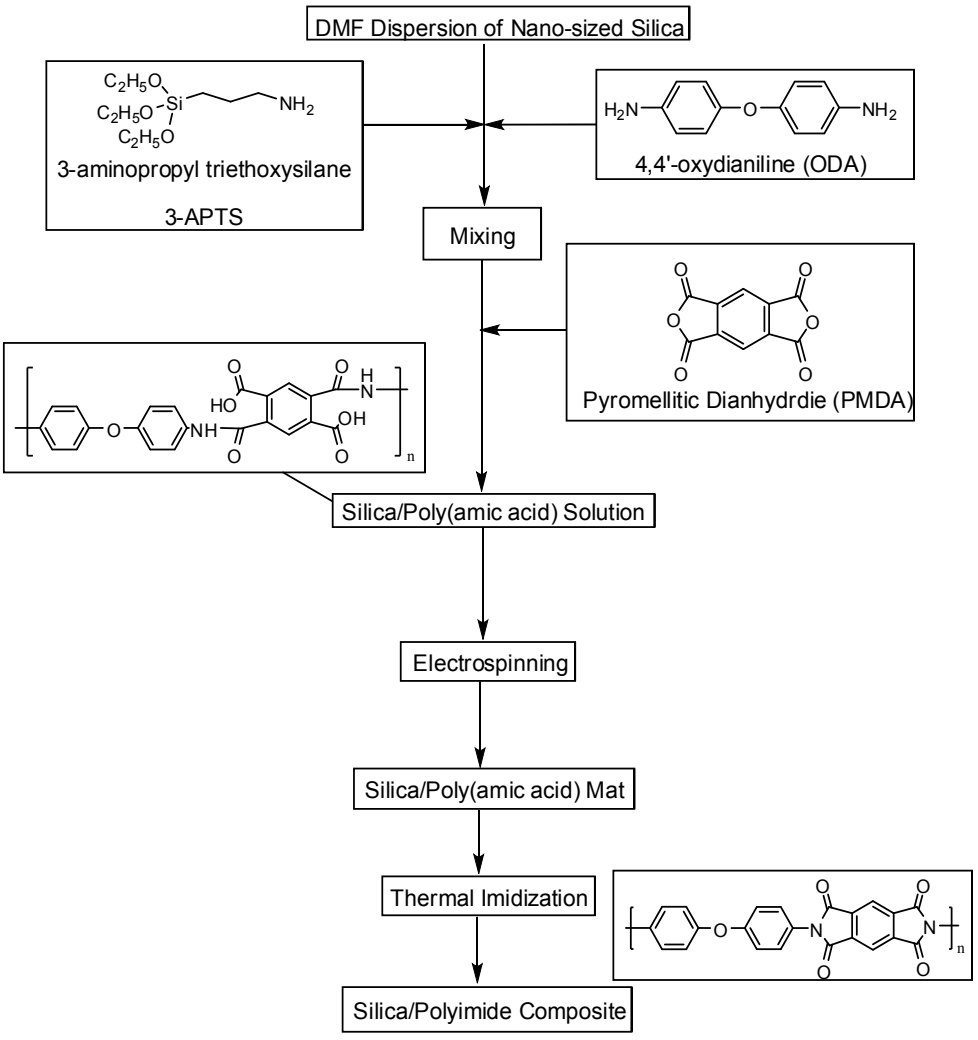

Scheme S1. Synthetic route of PI and Silica/PI nanocomposite.

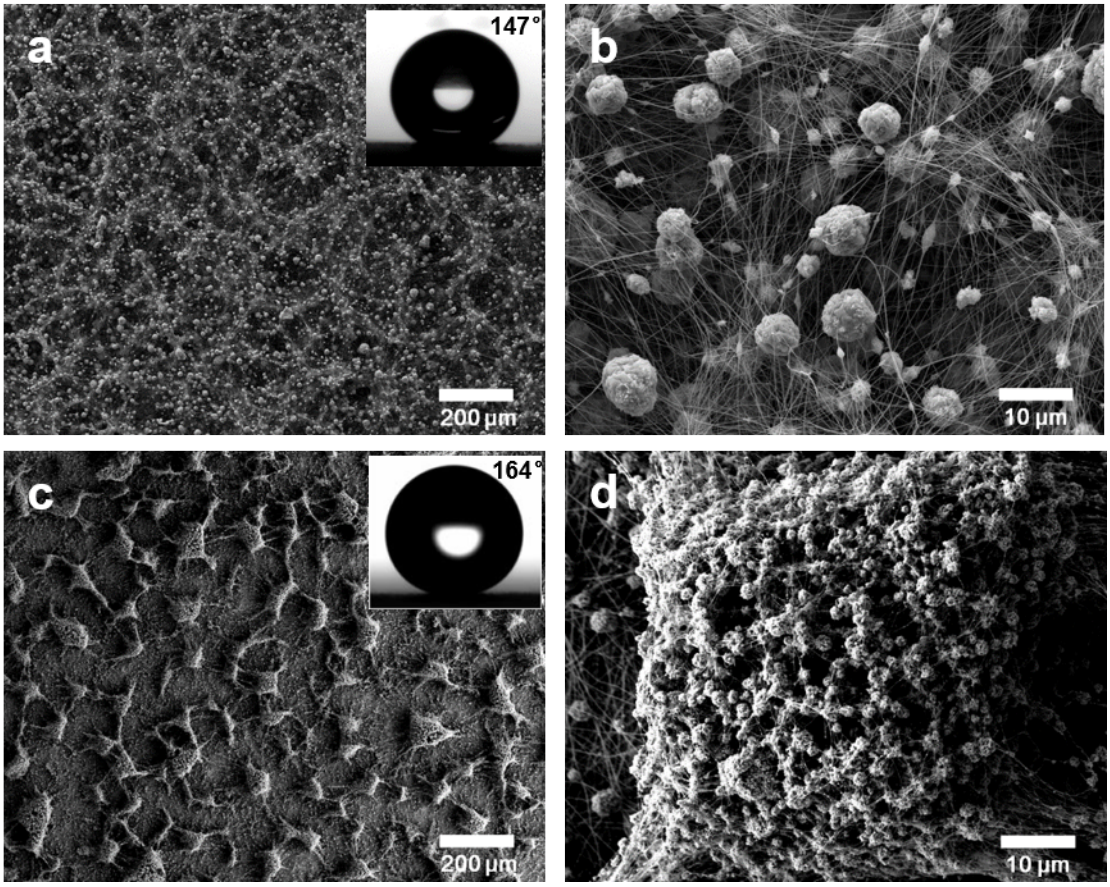

Figure S1. SEM demonstrations of the electrospun hybrid PI films with different amount of silica and their wettabilities. a): surficial structures of 10 wt% silica/PI films; b): enlargement of a). c) surficial structures of 60 wt% silica/PI films; d): enlargement of c). The 10 wt% silica/PI composite film was a self-standing film but without superhydrophobicity or self-cleaning property. The 60 wt% silica/PI after electrospinning was very similar to powder like coating rather than film. Although it was superhydrophobic, it had no mechanical usage.

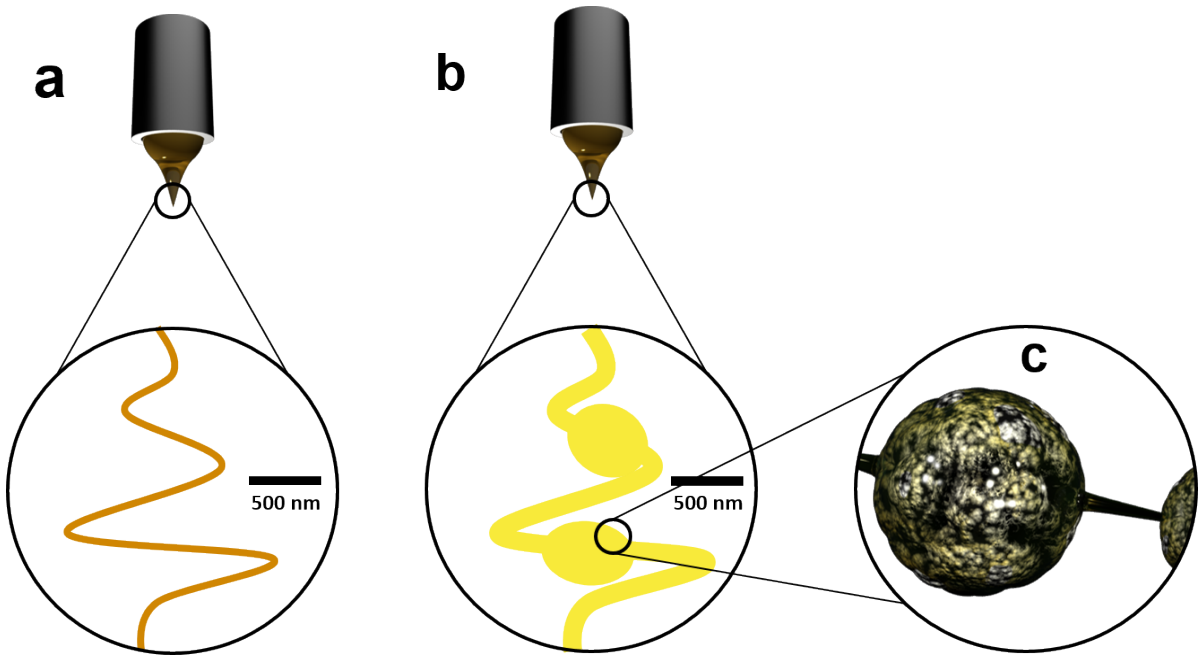

Figure S2. **Structural formation mechanism of the electrospun hybrid film**. a): In traditional electrospinning, nano-sized fibers were smoothly formed. Due to their sharply reduced diameters during the process, the solvents rapidly vaporized and the fibers solidified. However, in the situation described in our work, b): if the solution contained a large amount of nano-particles, inevitably the particles agglomerated to some extent. c): And these clustered particles were wetted by the solution. Such situation prevented the solvent from vaporizing rapidly due to the much larger radius on the clusters, leading to a non-solid state. These un-solidified parts would then merge together to form the continues block.

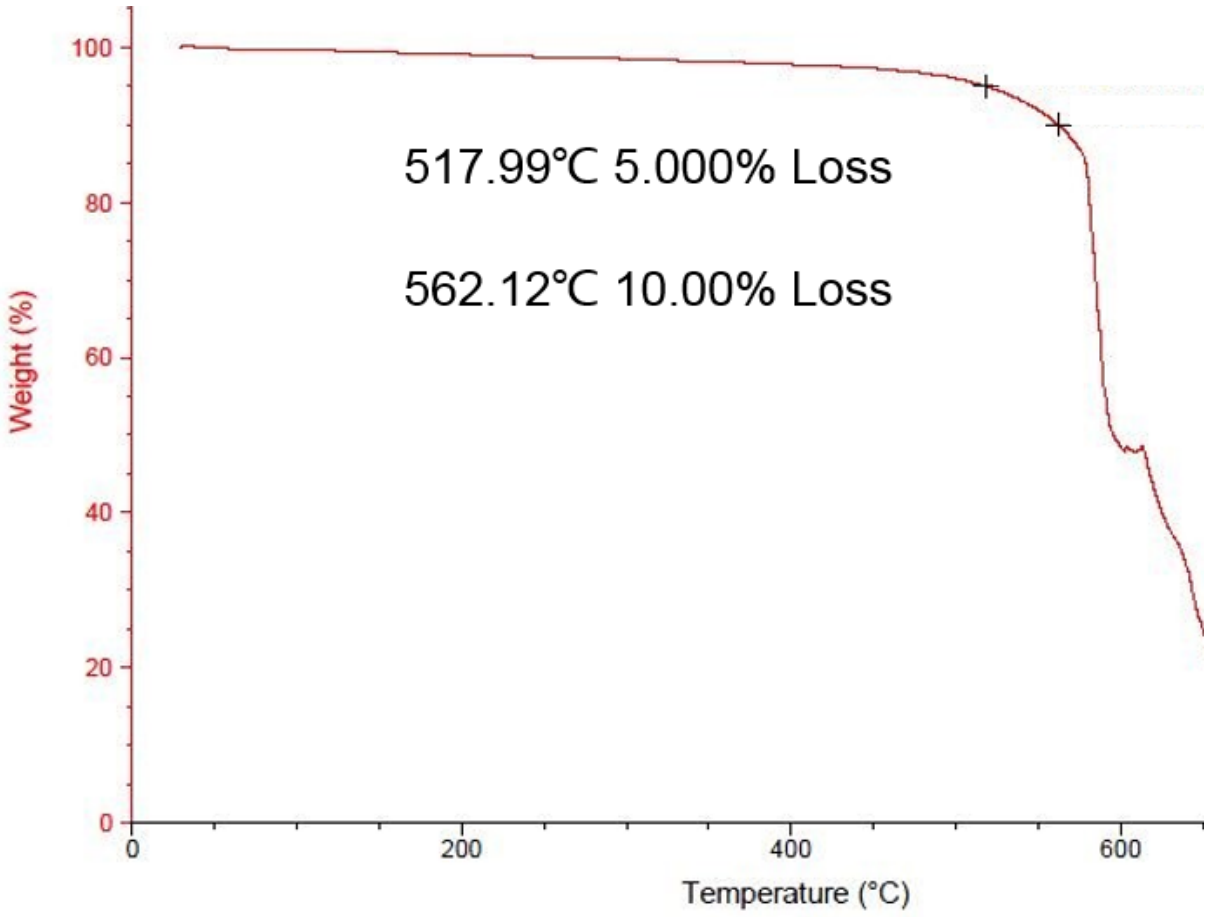

Figure S3. TGA of the electrospun silica/PI composite film.

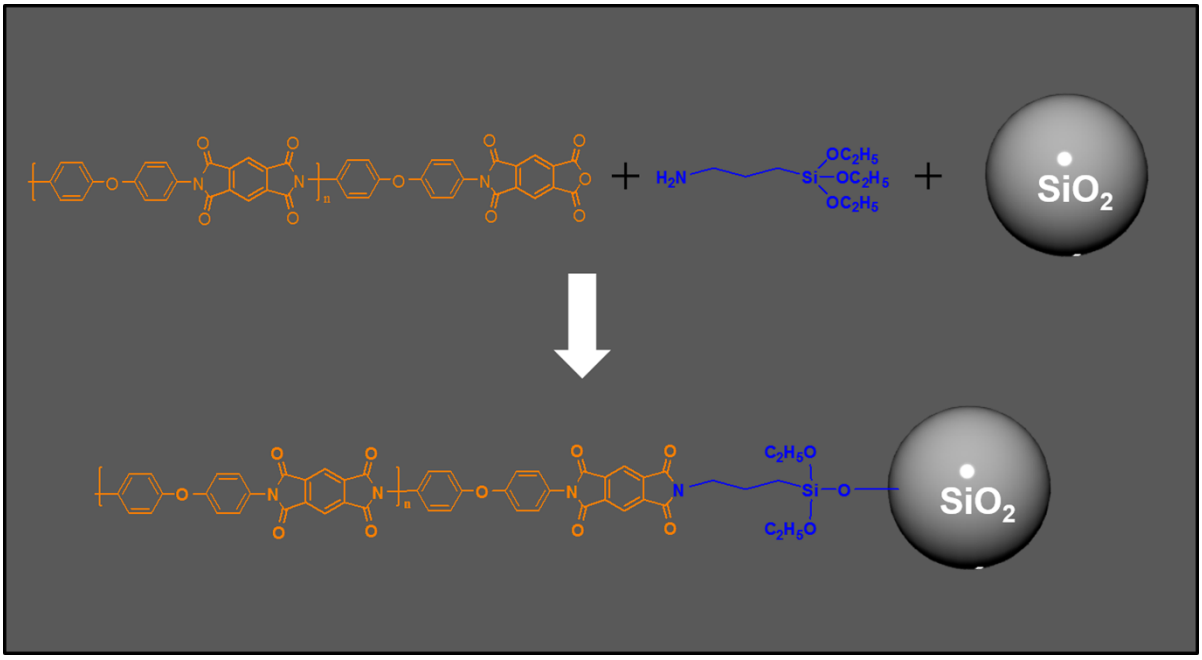

Figure S4. The speculation of coupling mechanism of 3-APTS, based on Ref. [S1-S3]. The 3-APTS agent served as the coupling agent which linked between PI matrix and Silica particles. The amino group of 3-APTS atacked the anhydride ended polymer chain-tip while the other side bonded with the surface silica particles. Such chemical bondings enabled the silica particles to be firmly embeded on the polyimide surfaces.

[S1] K. Sakai, T. C. Teng, A. Katada, T. Harada, K. Yoshida, K. Yamanaka, Y. Asami, M. Sakata, C. Hirayama, M. Kunitake, *Chem. Mater*., **2003**, *15*, 4091

[S2] K. C. Vrancken , K. Possemiers, P. van der Voort, et al., *Colloids and Surfaces A* , **1995** , *98*, 235

[S3] T. Jesionowski , A. Krysztafkiewicz, *Applied Surface Science* , **2001** , *172*, 18

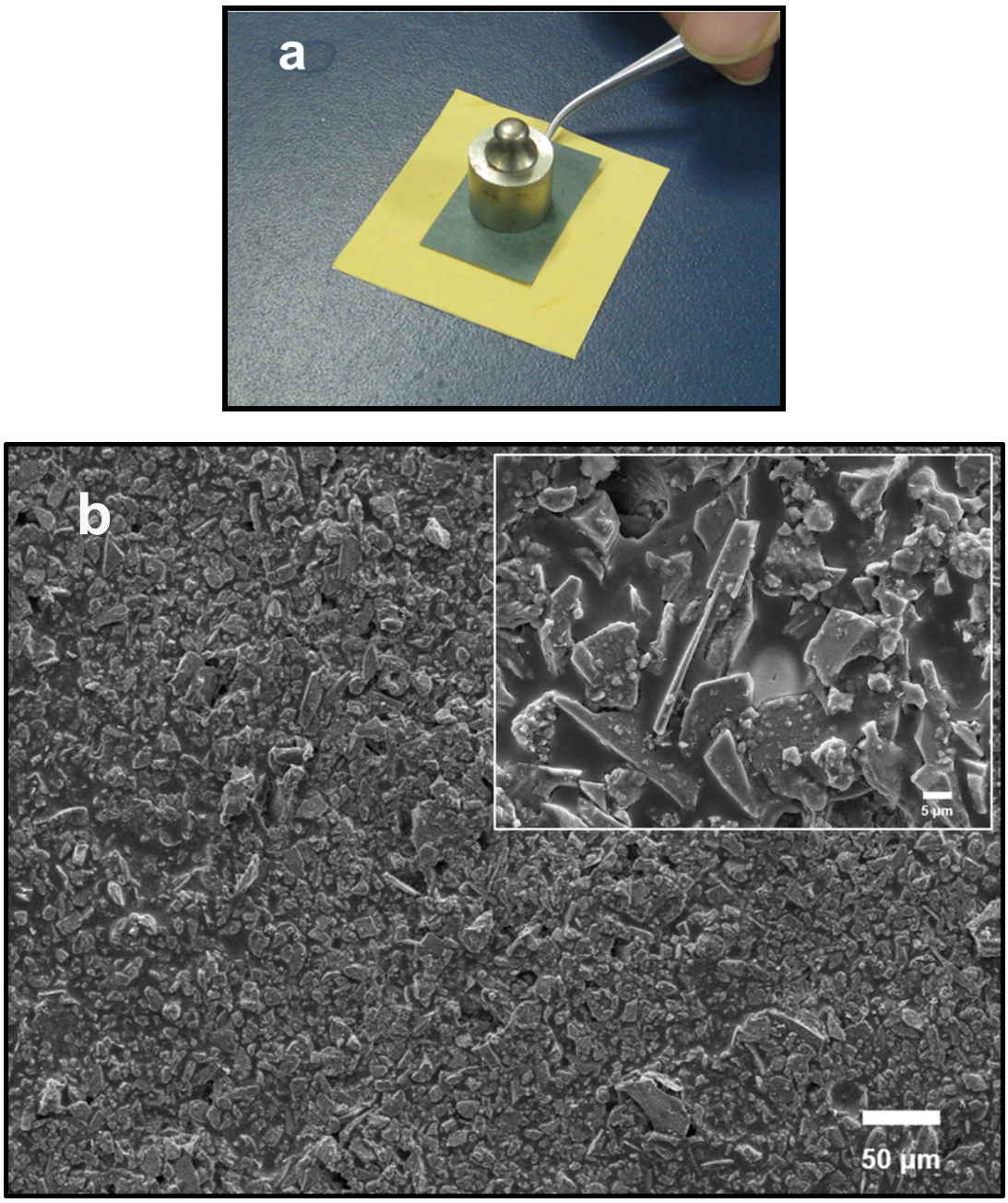

Figure S5. (a) Display of the abrasion test. A 20g metal weight was lying on the back of an abrasive paper (M20, particle sizes smaller than 20μm, whose SEM characterizations were given in (b)), applying an approximately 2.5kPa pressure on it. The rough side of the abrasive paper was directly attaching the very surface of the hybrid film. Then a drag force was driving the abrasive paper to generate abrasion at a speed of about 0.2m/s across the entire surface of the film. the scratching distance was about 4cm.