Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Fabrication of mechanically robust superhydrophobic steel surface with corrosion resistance property

Peng Wang[a,*], Tao Yao[a], Bo Sun[a], Tiejun Ci[a], Xiaoliang Fan[a], and Huilong Han[a]

[a]*School of Energy Power and Mechanical Engineering, North China Electric Power University, Baoding, 071003, China*

*Corresponding author: wang.peng.ncepu@foxmail.com

S1 A time-dependent morphological evolution

We have tracked the morphological evolution of the bare 1045 steel substrates by characterizing the samples etched at various reaction times (*t*). When the steel foil was immersed into the mixture of NaClO and H_2O_2, the reaction was intense and a large amount of bubble generated. Due to the existence of defect and crystallinity in the steel surface, micro-cavity structure tended to be formed (Fig. S1a). At t = 3 min, a porous structure consisted of nanoplates was obtained (Fig. S1b). It should be noted that the reaction become smoother as the reaction time increased. At t = 8 min, both nanoparticles and nanoplates were obtained on the surface (Fig. S1c). At t = 40 min, the reaction became very smooth and only a small amount of bubbles generated. Then, nanoparticles with hierarchical micro/nano cavities appeared (Fig. S1d).

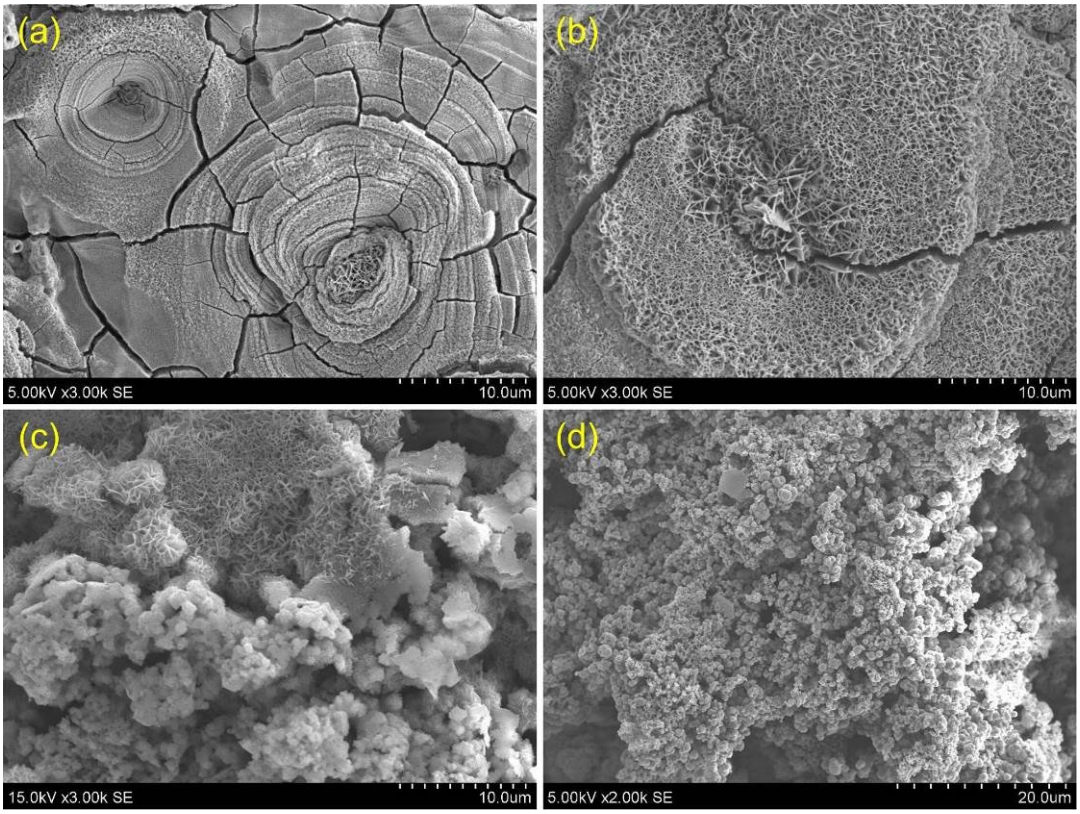

Figure S1. SEM images of steel surfaces at various reaction times of (a) 1, (b) 3, (c) 8, and (d) 40 min.

S2 XPS measurement

XPS measurement was performed to further investigate the surface chemical composition of the as-prepared superhydrophobic surface. Fig. S2a shows the survey spectra of the sample. It can be found that the Si 2p, C 1s, O 1s, F 1s and Fe 2p peaks are detected from the surface. From the Fe 2p spectra (Fig. S2b), the Fe $2p_{1/2}$and Fe $2p_{3/2}$ can be found in the binding energy of 724.63 eV and 710.98 eV, respectively. The spin-orbit coupling energy gap is 13.65 eV, which indicates that Fe^{3+} is the main valence state of iron [1]. Moreover, the only peak located at 688.8 eV is attributed to the C-F species of FAS (Fig. S2c) [2]. Fig. S2d shows the multi-element spectra of C 1s, observed peaks at 284.2, 285.0, 286.1, 287.6, 291.3 and 292.7 eV are ascribed to C-Si, C-C, C-O, C-CF, $-CF_2$ and $-CF_3$, respectively [2,3].

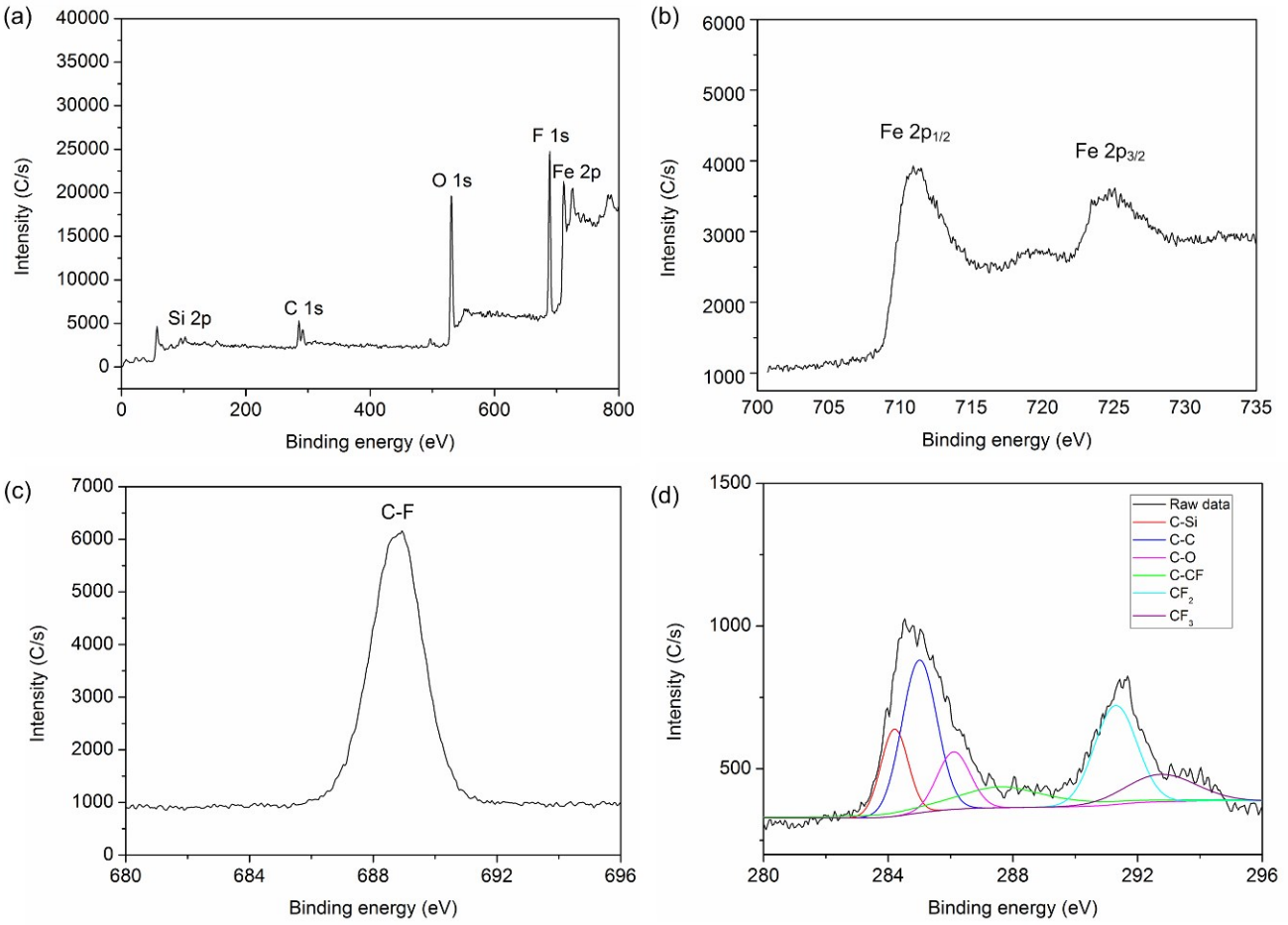

Figure S2. (a) Survey XPS spectrum of the as-prepared superhydrophobic surface; (b) Fe 2p，(c) F 1s and (d) C 1s XPS spectrum of the sample.

S3 The composition of the gas generated during the etching process

The composition of the gas generated during the etching process was further tested. As shown in Fig. S3a and S3b, the color of the wet blue litmus paper was not changed during the etching process, which indicates that no Cl_2 gas was generated. Moreover, dazzling spark was found in Fig. S3c and S3d, which confirmed the generation of O_2 gas.

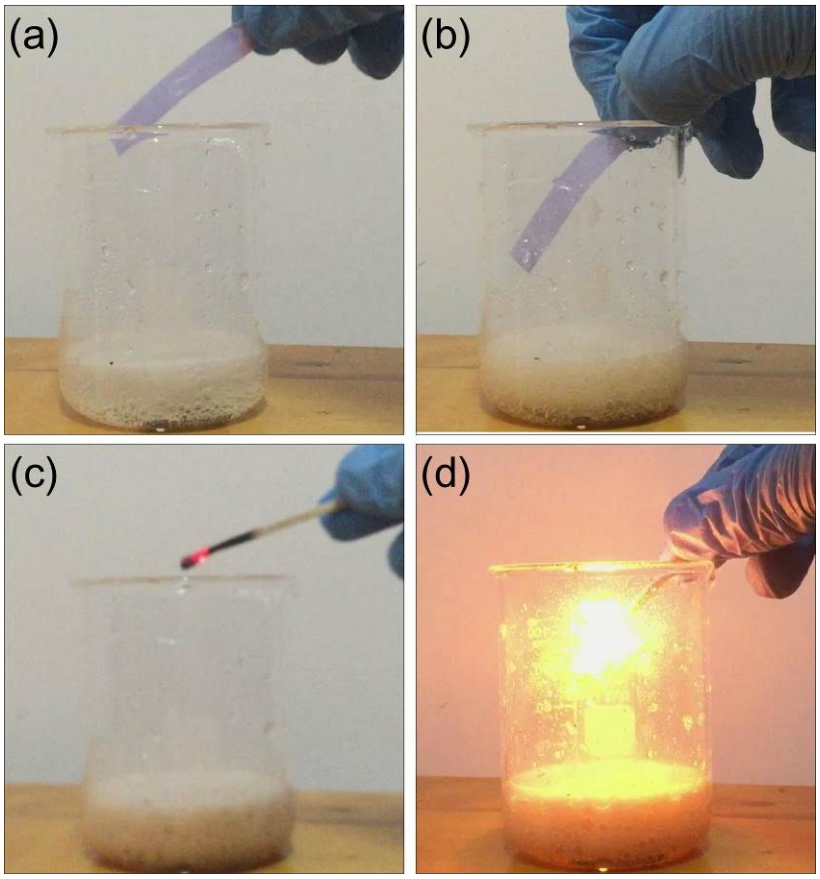

Figure S3. (a and b) The performance of wet blue litmus paper during the etching process; (c and d) the performance of burning match during the etching process.

S4 The SEM image of the surface after nine cycles of sandpaper abrasion

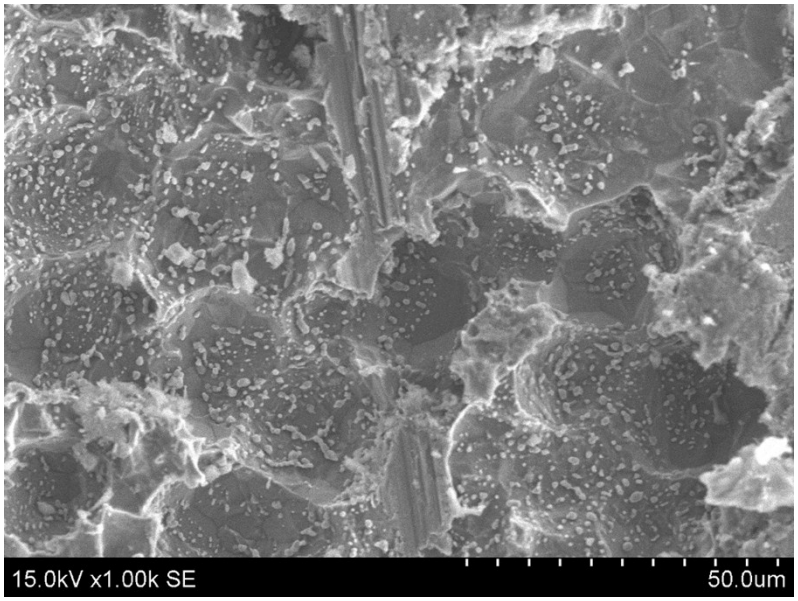

Figure S4. The SEM image of the surface after nine cycles of sandpaper abrasion.

References

1. Y. Fan, Y. He, P. Hao, X. Chen, B. Liu, A facile electrodeposition process to fabricate corrosion-resistant superhydrophobic surface on carbon steel. *Appl. Surf. Sci.*, 2016, **368**, 435.
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3. R. V. Lakshmi, P. Bera, C. Anandan, B. J. Basu, Effect of the size of silica nanoparticles on wettability and surface chemistry of sol-gel superhydrophobic and olephobic nanocomposite coating. *Appl. Surf. Sci.*, 2014, **320**, 780.