Mechanoelectrochemical Catalysis of the Effect of Elastic Strain on a Platinum nanofilm for the ORR Exerted by a Shape Memory Alloy Substrate

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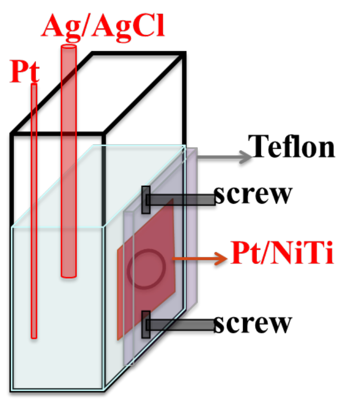

Figure S1. Schematic diagram of a three-electrode electrochemical cell.

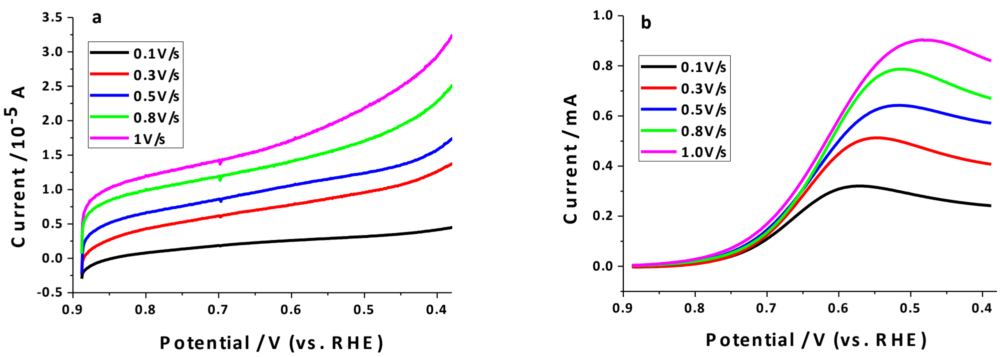

Figure S2. Polarization curves of the compressively-strained 10 nm Pt nanofilm of sample 1 (underwent a thermal cycling process: RT → 200˚C → RT) at different scan rates in the (a) Ar-saturated 0.5 M H_2SO_4 solution and (b) O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

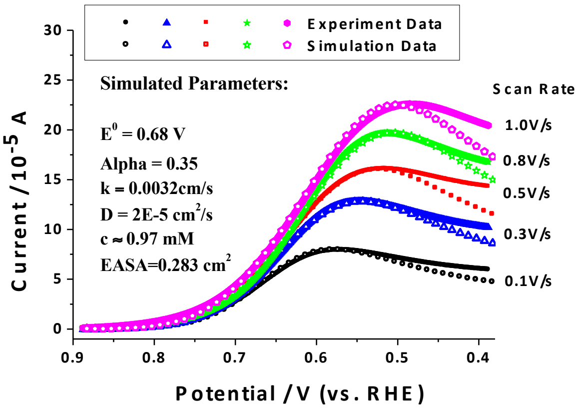

Figure S3. Experimental and simulated results of the ORR of the compressively-strained 10 nm Pt nanofilm of sample 1 in the O_2-saturated 0.5 M H_2SO_4 solution.

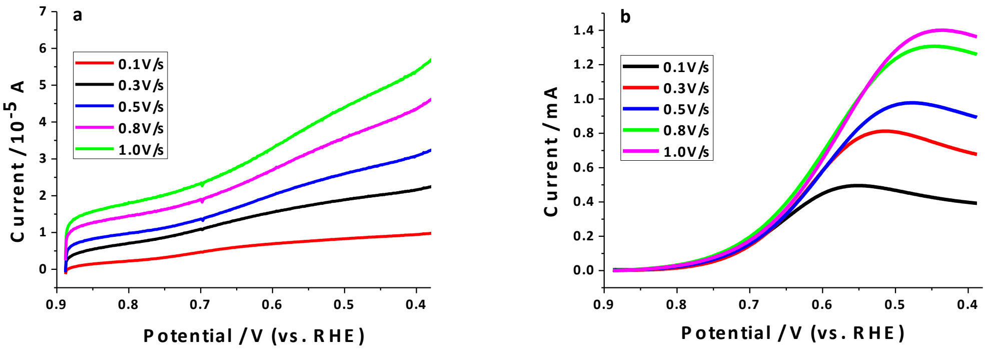

Figure S4. Polarization curves of the tensilely-strained 10 nm Pt nanofilm of sample 1 (underwent a thermal cycling process: RT → -100˚C → RT) at different scan rates in the (a) Ar-saturated 0.5 M H_2SO_4 solution and (b) O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

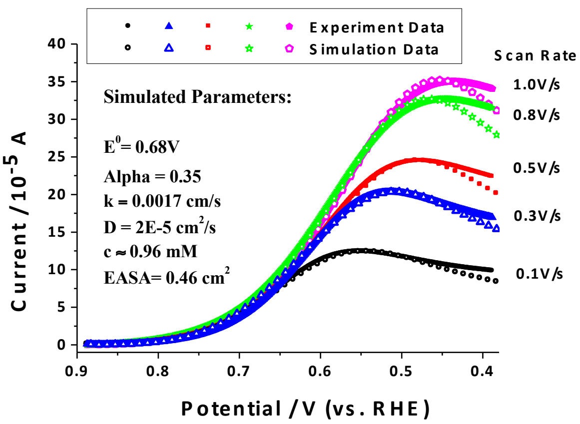

Figure S5. Experimental and simulated results of the ORR of the tensilely-strained 10 m Pt nanofilm at sample 1 in the O_2-saturated 0.5 M H_2SO_4 solution.

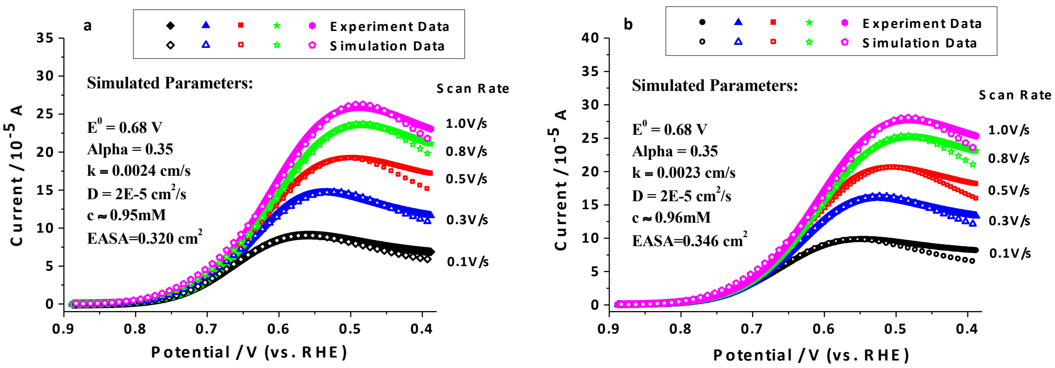

Figure S6. Experimental and simulated results of the ORR of the pristine 10 nm Pt nanofilm of (a) sample 2 and (b) sample 3 in the O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

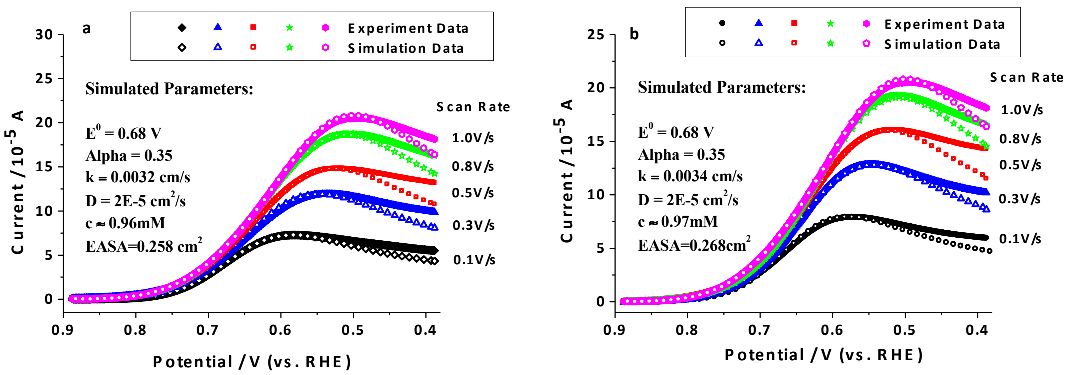

Figure S7. Experimental and simulated results of the ORR of the compressively-strained 10 nm Pt nanofilm (underwent a thermal cycling process: RT → 200˚C → RT) of (a) sample 2 and (b) sample 3 in the O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

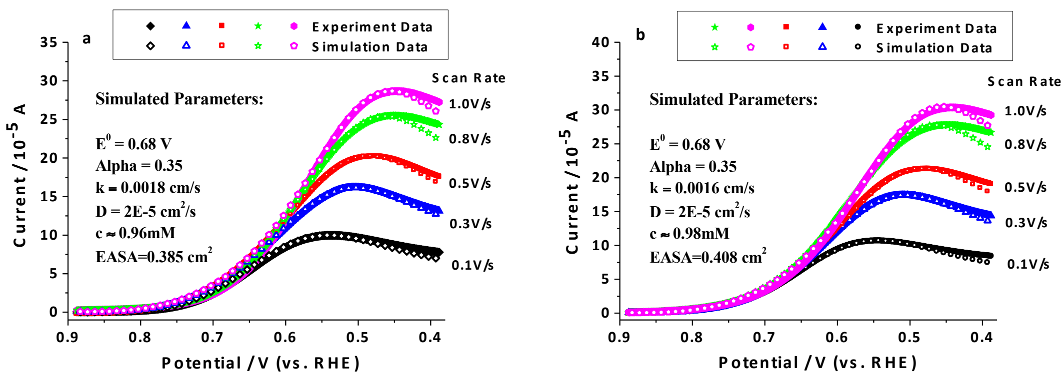

Figure S8. Experimental and simulated results of the ORR of the tensilely-strained 10 nm Pt nanofilm (underwent a thermal cycling process: RT → -100˚C → RT) of (a) sample 2 and (b) sample 3 in the O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

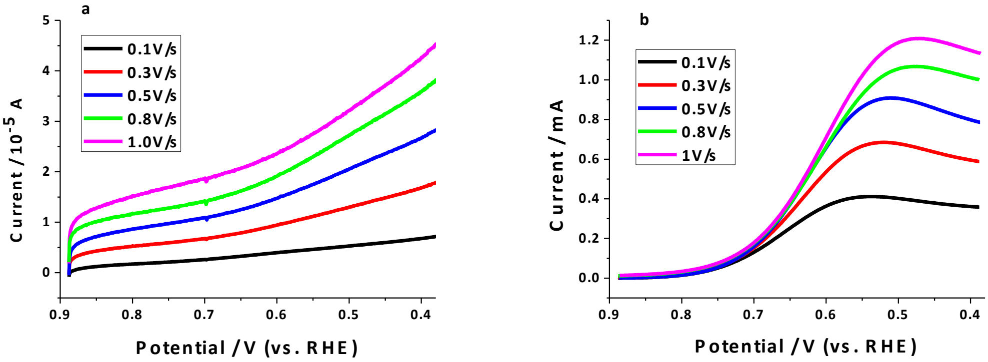

Figure S9. Polarization curves of the pristine 5 nm Pt nanofilm at different scan rates in the (a) Ar-saturated 0.5 M H_2SO_4 and (b) O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

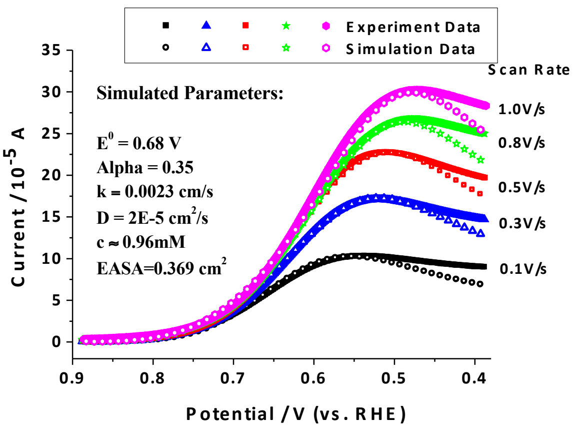

Figure S10. Experimental and simulated results of the ORR of the pristine 5 nm Pt nanofilm.

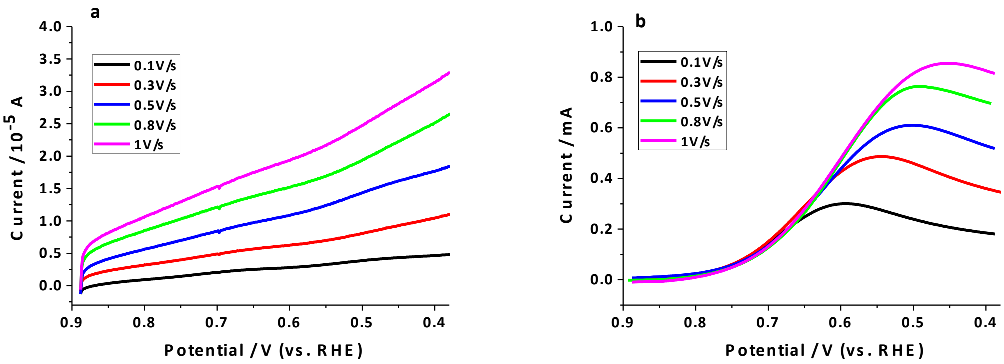

Figure S11. Polarization curves of the compressively-strained 5 nm Pt nanofilm (underwent a thermal cycling process: RT → 200˚C → RT) at different scan rates in the (a) Ar-saturated 0.5 M H_2SO_4 solution and (b) O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

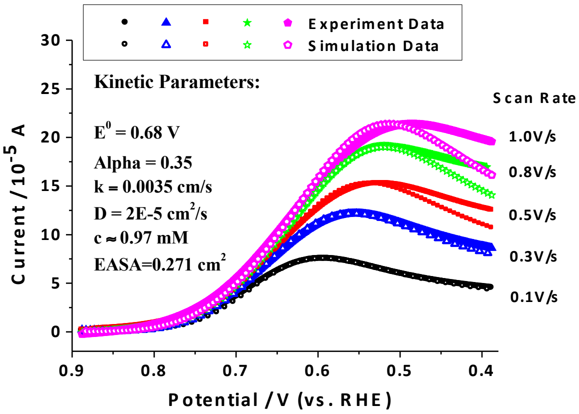

Figure S12. Experimental and simulated results of the ORR of the compressively-strained 5 nm Pt nanofilm in the O_2-saturated 0.5 M H_2SO_4 solution.

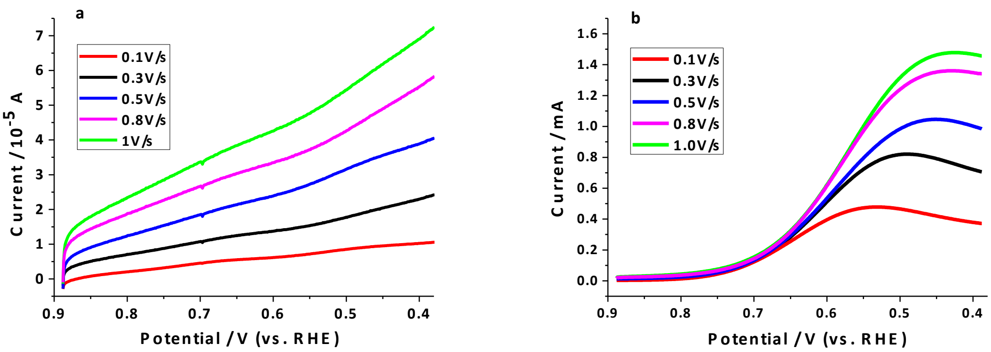

Figure S13. Polarization curves of the tensilely-strained 5 nm Pt nanofilm (underwent a thermal cycling process: RT → -100˚C → RT) at different scan rates in the (a) Ar-saturated 0.5 M H_2SO_4 solution and (b) O_2-saturated 0.5 M H_2SO_4 solution at room temperature.

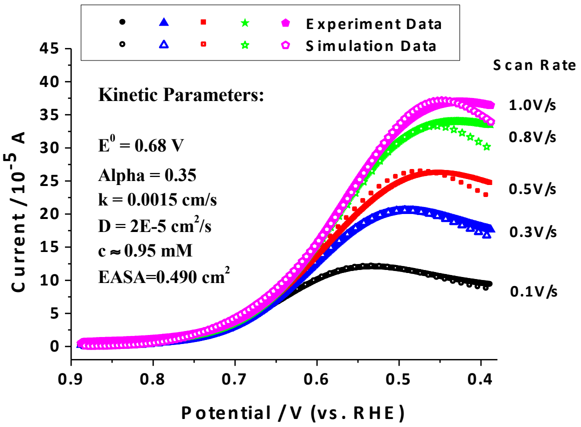

Figure S14. Experimental and simulated results of the ORR of the tensilely-strained 5 nm Pt nanofilm in the O_2-saturated 0.5 M H_2SO_4 solution.

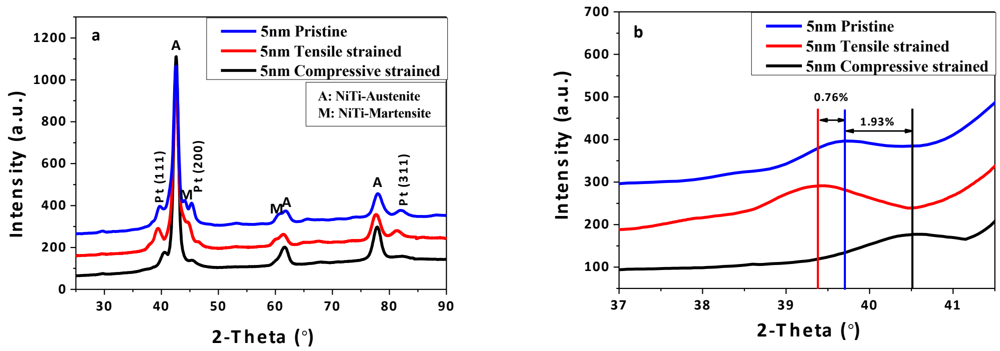

Figure S15. Grazing Incident X-ray diffraction pattern of 5 nm Pt/NiTi substrate sample: (a) Whole pattern; (b) Magnification of the Pt-(111) diffraction peak.

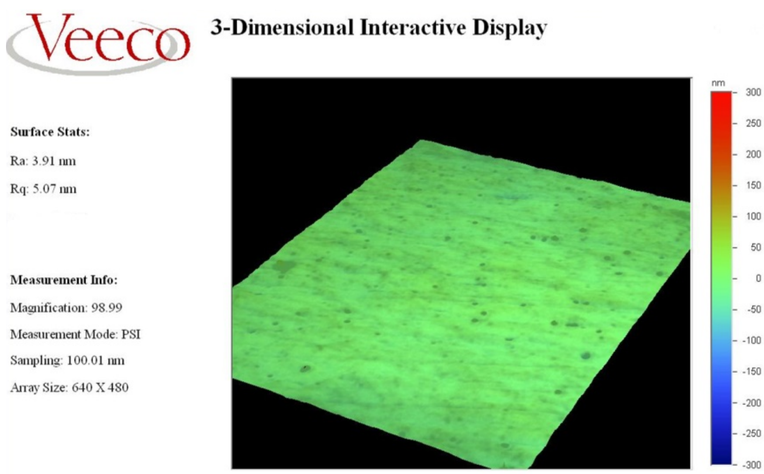

Figure S16. 3-D interactive display of the NiTi substrate surface tested by the PSI measure mode of Wyko Optical Profiler (vertical resolution is < 0.01 nm)

From Figure S16, the mean roughness Ra of the NiTi substrate is about 4 nm. And the Pt nanofilm must dense enough to avoid Ni and Ti elements leaching in the acid solution and ensure a high load transfer efficiency from the substrate to the nanofilm. So the minimum film thickness we could use is 5 nm.

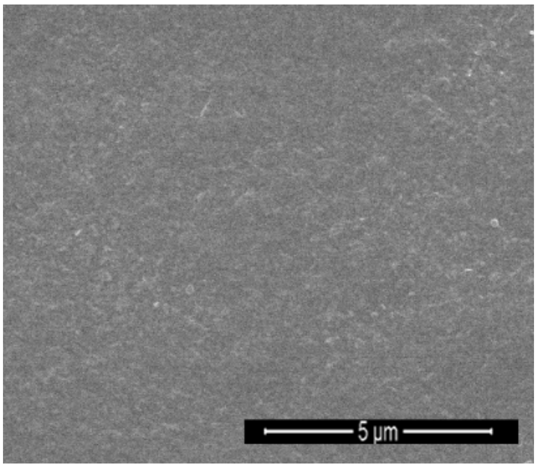

Figure S17. SEM image of the 10 nm Pt/NiTi substrate sample to show the surface morphology of Pt nanofilm

From Figure S17, Pt nanofilm is quite uniform and dense in a large scale. Also, considering that the elements release rate of NiTi SMA in acid solutions is less than 1μg/cm^2 per week[1], there should be negligible leaching during the electrochemical experiment (around one hour). As a result, the substrate leaching issue has not been taken into account in our research.

Reference

(1) Uhlig, H. H.; Revie, R. W. *Uhlig's corrosion handbook*; John Wiley & Sons, **2011**; Vol. 51, page 540.