

Modulating Catalytic Activity and Durability of PtFe Alloy Catalysts for Oxygen Reduction Reaction Through Controlled Carbon Shell Formation

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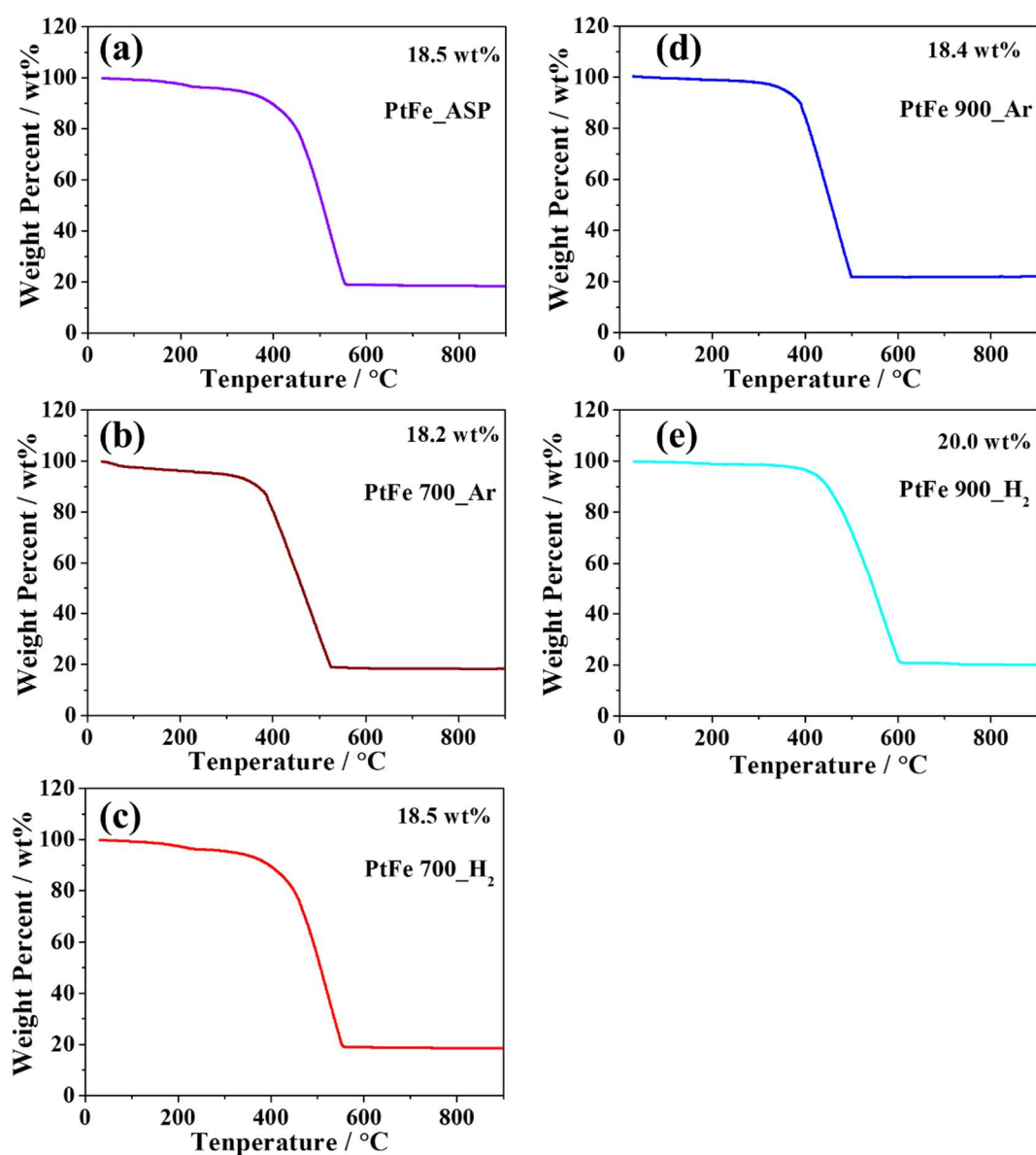


Figure S1. TGA data to estimate the metal loading of (a) PtFe_ASP, (b) PtFe 700_Ar, (c) PtFe 700_H₂, (d) PtFe 900_Ar, and (e) PtFe 900_H₂ catalysts.

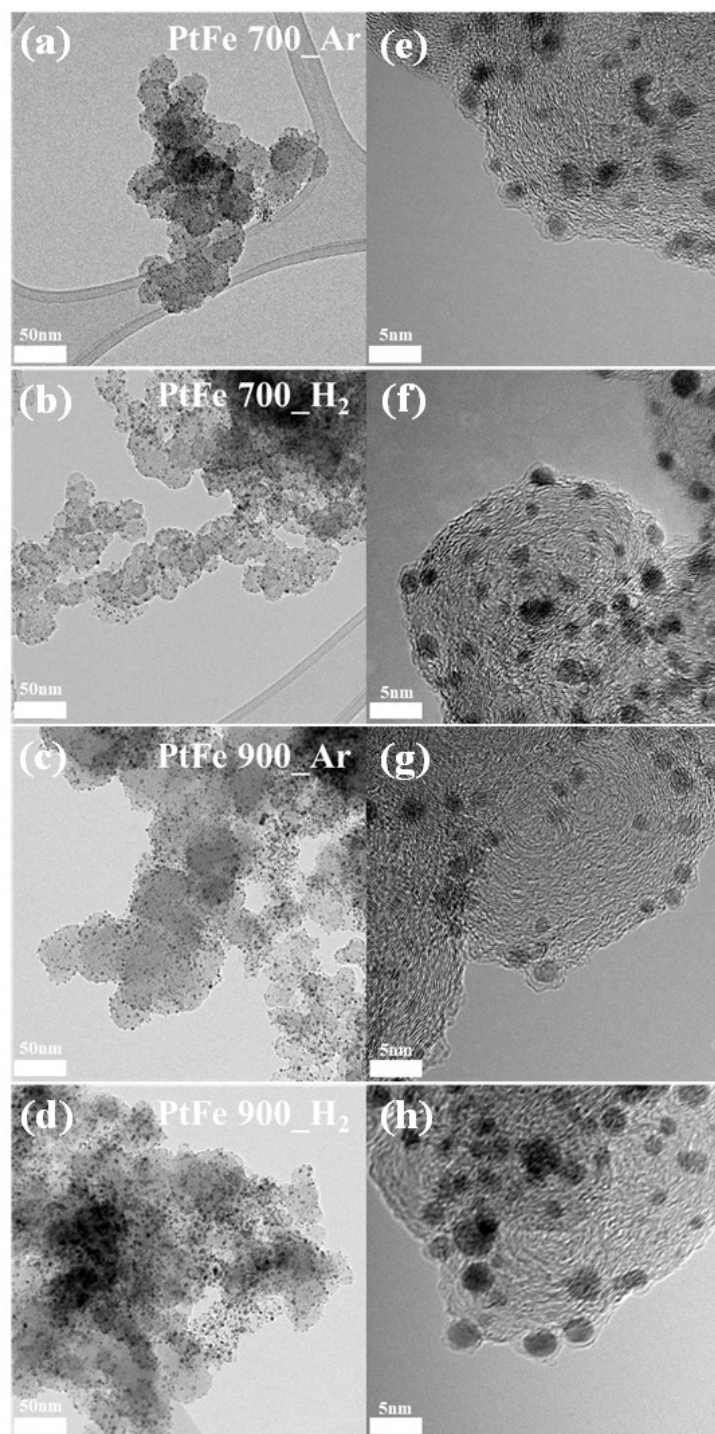


Figure S2. Low-resolution TEM images of (a) PtFe 700_Ar, (b) PtFe 700_H₂, (c) PtFe 900_Ar and (d) PtFe 900_H₂. Magnified TEM images of (e) PtFe 700_Ar, (f) PtFe 700_H₂, (g) PtFe 900_Ar and (h) PtFe 900_H₂.

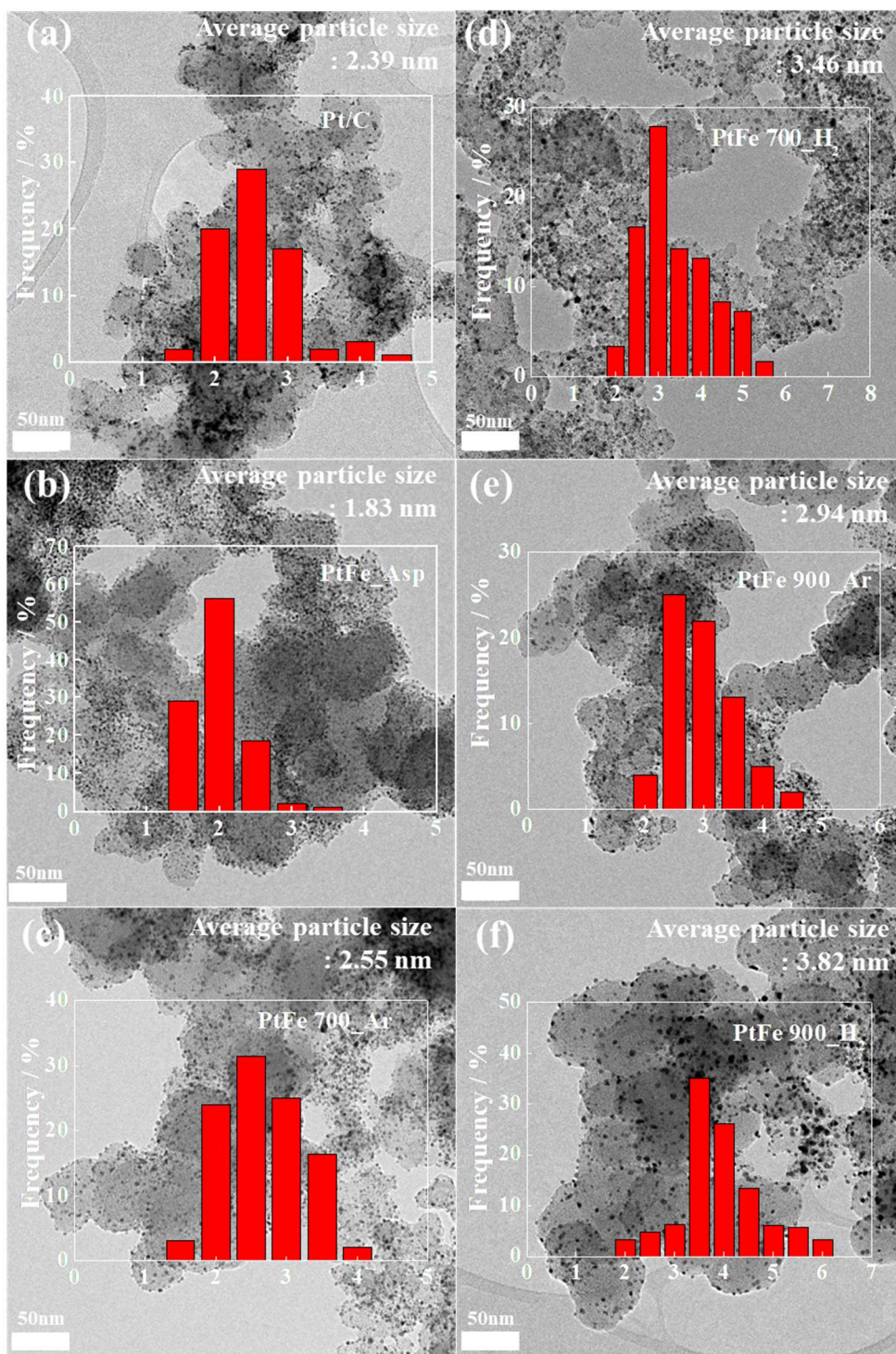


Figure S3. TEM images and particle size distribution of (a) commercial Pt/C, (b) PtFe_ASP, (c) PtFe 700_Ar, (d) PtFe 700_H₂, (e) PtFe 900_Ar, and (f) PtFe 900_H₂.

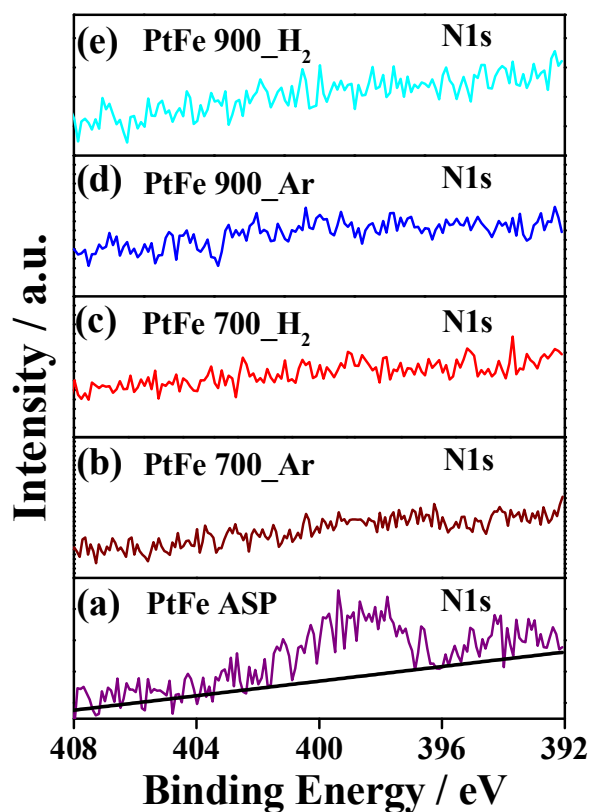


Figure S4. N 1s core level XPS spectra of (a) PtFe_ASP, (b) PtFe 700 Ar, (c) PtFe 700 H₂, (d) PtFe 900 Ar, and (e) PtFe 900 H₂.

Table S1. Comparison of ECSA values of commercial Pt/C and different heat-treated PtFe samples (before and after 5000 potential cycles).

	Before ADT	After ADT
Pt/C	94.18	38.63
PtFe 700_Ar	22.45	-
PtFe 900_Ar	13.72	-
PtFe 700_H ₂	34.49	32.96
PtFe 900_H ₂	22.69	23.05

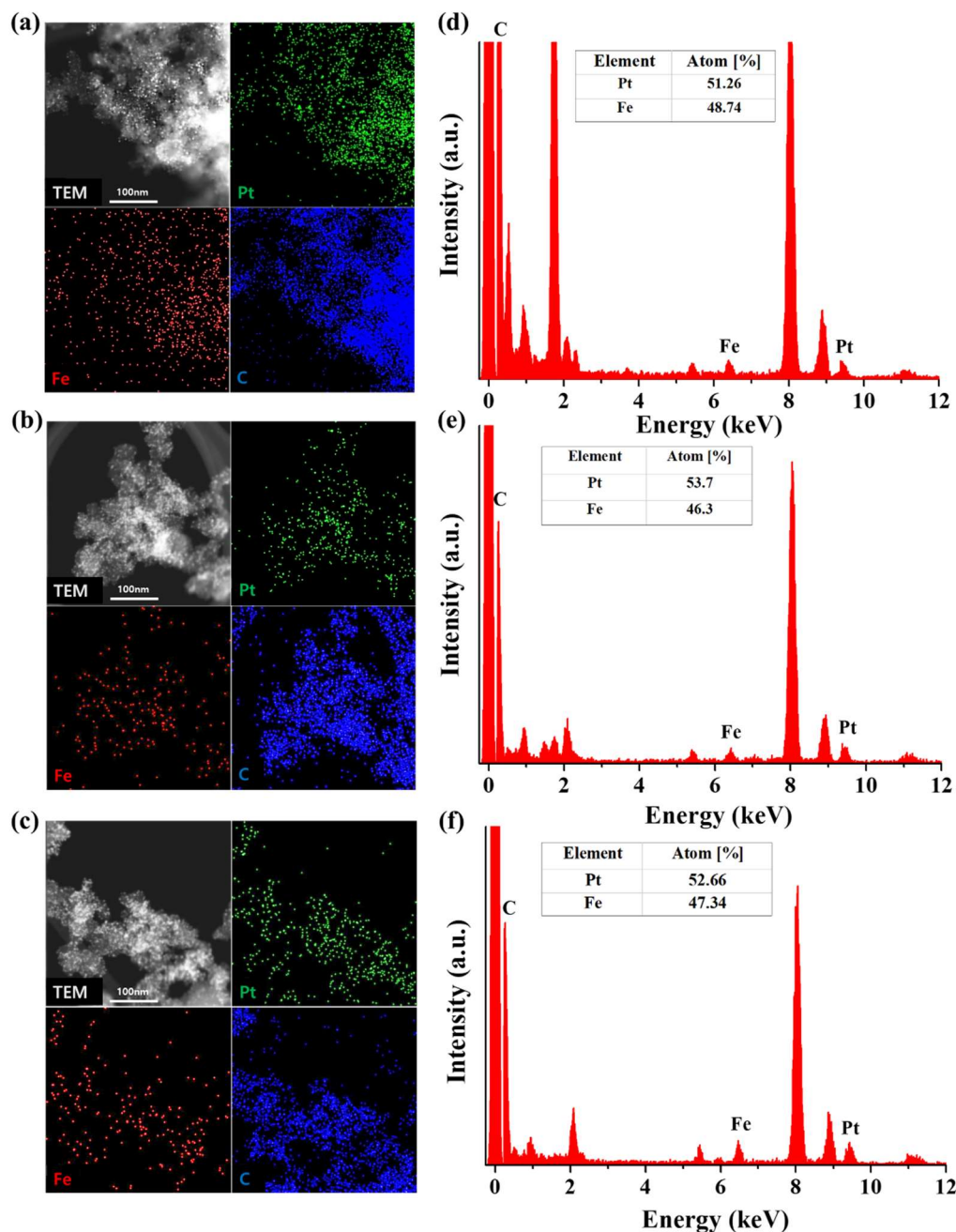


Figure S5. TEM image and elemental maps of Pt, Fe, and C for (a) PtFe ASP, (b) PtFe 700_H₂, and (c) PtFe 900_H₂. The corresponding EDX spectra of (d) PtFe ASP, (e) PtFe 700_H₂, and (f) PtFe 900_H₂, respectively.

Energy-dispersive X-ray spectroscopy (EDX) analysis were performed to identify elemental distribution of PtFe ASP and different heat-treated PtFe catalysts. The elemental map of PtFe alloy catalyst revealed uniform distribution of elements, Pt and Fe. Furthermore, in the corresponding EDX spectra, it was confirmed that the prepared PtFe nanoparticles have near equivalent atomic ratios of Pt to Fe (Pt:Fe = 1:1).

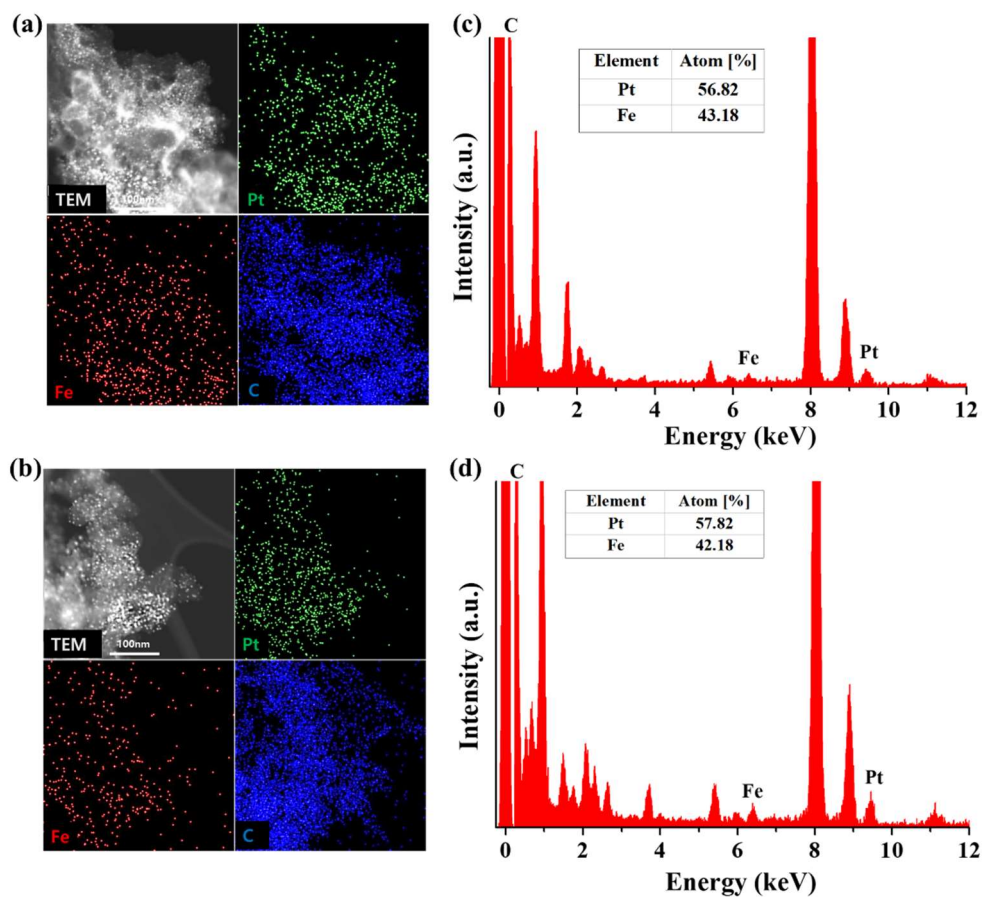


Figure S6. TEM image and elemental maps of Pt, Fe, and C for (a) PtFe 700_H₂ and (b) PtFe 900_H₂ after the ADTs. The corresponding EDX spectra of (c) PtFe 700_H₂ and (d) PtFe 900_H₂, respectively.

After the ADTs of PtFe 700_H₂ and PtFe 900_H₂ catalysts, their EDX mapping images showed no obvious change in the density of elemental distribution (Figure S6a and b). Notably, the corresponding EDX spectra (Figure S6c and d) revealed that the atomic ratios of Pt:Fe (1:1) were hardly changed even after the ADTs, indicating no significant loss of Pt or Fe atoms by dissolution.