

Supporting information

Screening of carbon-supported platinum electrocatalysts using Frumkin adsorption isotherms

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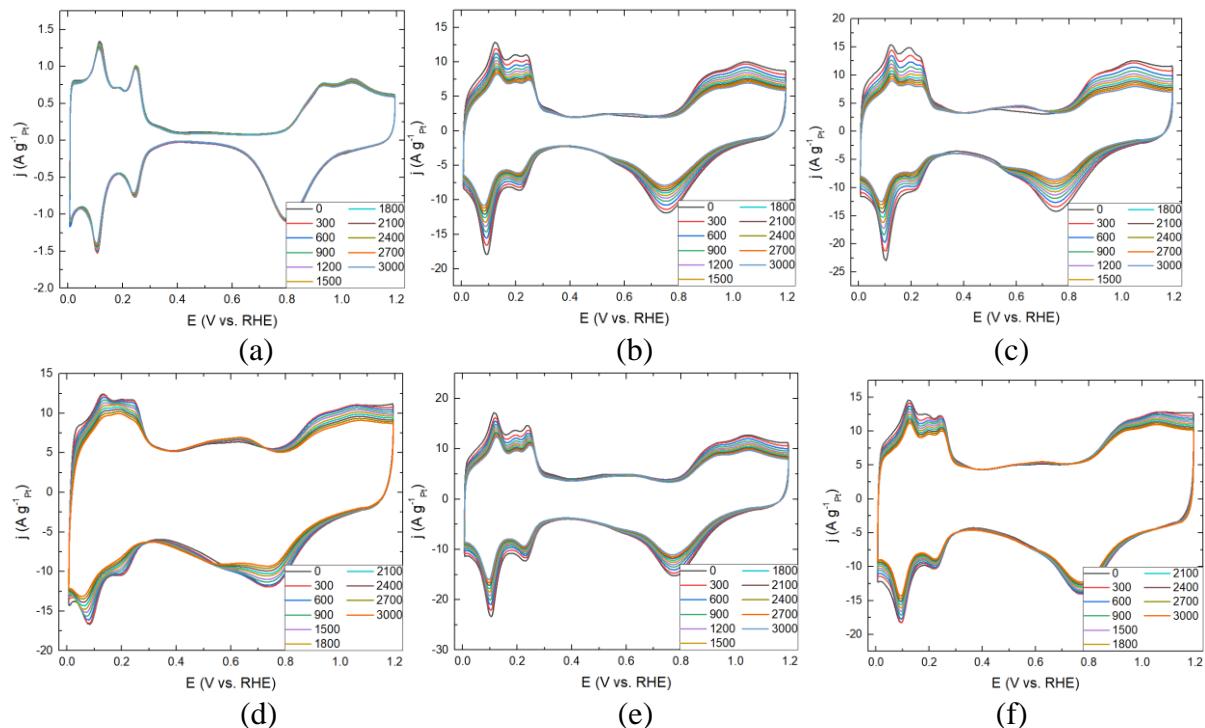
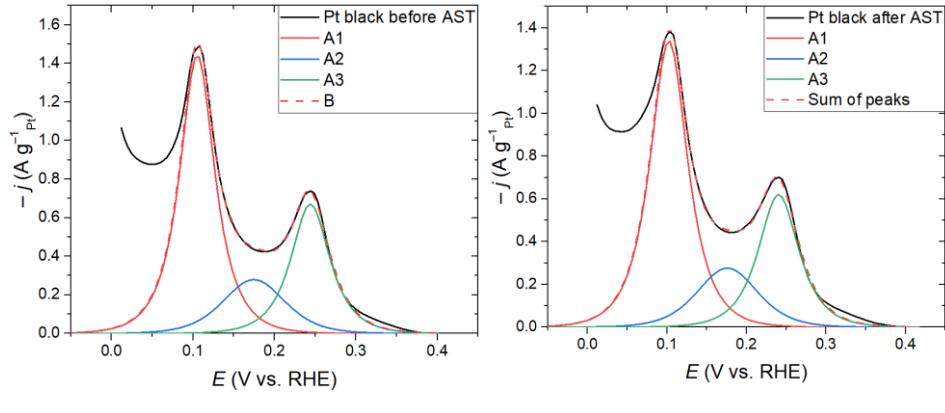


Figure S1. Cyclic voltammograms (CVs) of Pt black (a), Pt⁴⁰/C (b), Pt²⁰/C (c), Pt²⁰/RGO (d), Pt²⁰/CNF (e) and Pt²⁰/CNT (f), recorded after each 300 cycles of the AST in N₂ saturated 0.5 M H₂SO₄.



(a)

(b)

Figure S2. CVs hydrogen adsorption region and deconvoluted peaks of Pt black before (a) and after 3000 AST cycles (b).

Table S1. Computed values of adsorption isotherm parameters of Pt black: E_m – the peak position; FWHM – the peak full width at half maximum; g – the interaction constant; $\Delta G_{ads}^0 i$ – the hydrogen adsorption energy, corresponding to the i -th peak; ESA_i – the contribution of the i -th peak to the ESA , P_i – the normalized contribution of the i -th peak to the ESA .

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol $^{-1}$	ESA_i , m 2 g $^{-1}$ Pt	P_i , %
A1	0.105	50	-1.515	-8.3	2.2	55.1
A2	0.175	89	-0.001	-16.9	0.7	17.1
A3	0.244	56	-1.296	-22.0	1.1	27.8
After AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol $^{-1}$	ESA_i , m 2 g $^{-1}$ Pt	P_i , %
A1	0.102	56	-1.307	-8.3	2.2	55.6
A2	0.176	89	0.000	-17.0	0.7	17.0
A3	0.240	60	-1.145	-21.8	1.1	27.3

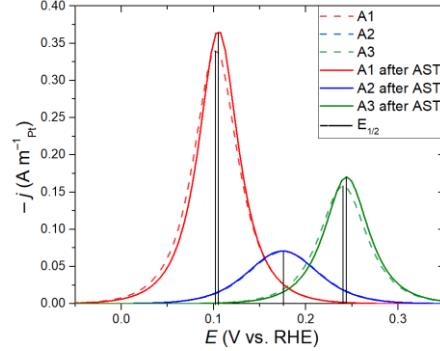


Figure S3. Hydrogen adsorption peaks of Pt black before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA .

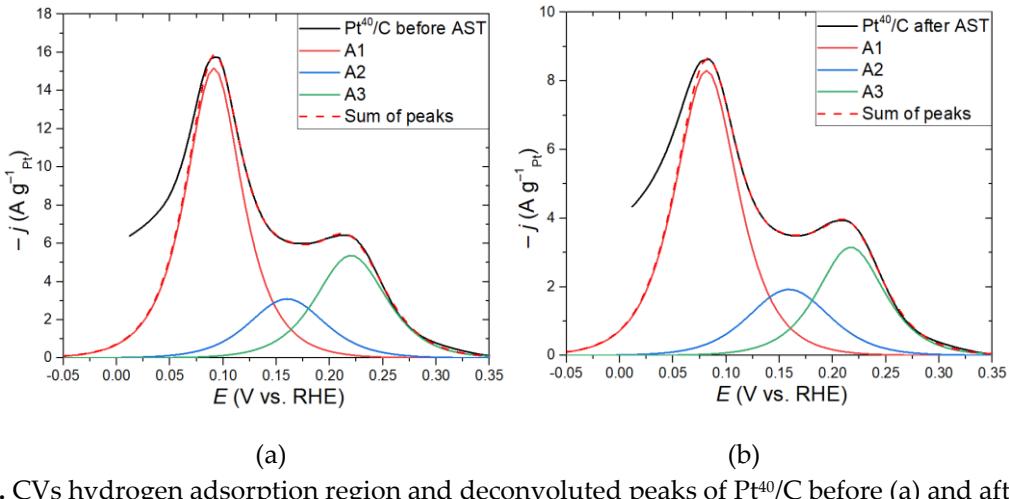


Figure S4. CVs hydrogen adsorption region and deconvoluted peaks of Pt⁴⁰/C before (a) and after 3000 AST cycles (b).

Table S2. Computed values of adsorption isotherm parameters of Pt⁴⁰/C.

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.091	62	-1.056	-7.5	27.0	59.2
A2	0.160	83	-0.226	-15.2	7.0	15.5
A3	0.220	78	-0.450	-20.7	11.5	25.3
After AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.082	69	-0.760	-6.9	16.2	59.3
A2	0.159	89	-0.001	-15.3	4.6	17.0
A3	0.217	74	-0.595	-20.2	6.5	23.7

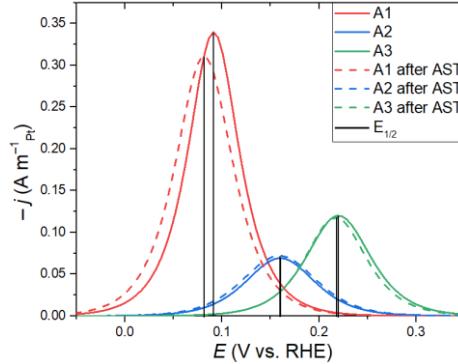


Figure S5. Hydrogen adsorption peaks of Pt⁴⁰/C before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA.

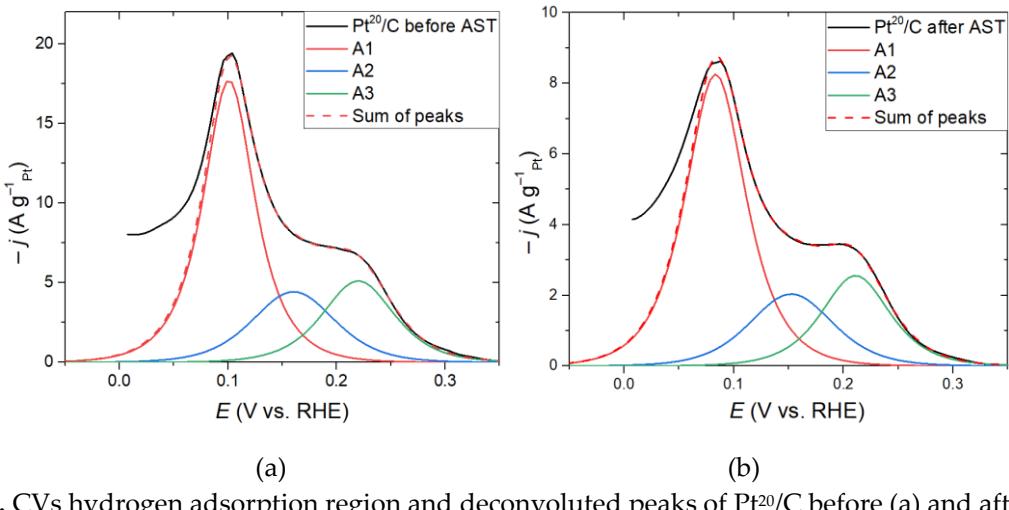


Figure S6. CVs hydrogen adsorption region and deconvoluted peaks of Pt²⁰/C before (a) and after 3000 AST cycles (b).

Table S3. Computed values of adsorption isotherm parameters of Pt²⁰/C.

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^{0,i}$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.101	56	-1.287	-8.2	29.0	57.3
A2	0.160	89	-0.001	-15.5	10.7	21.1
A3	0.220	78	-0.445	-20.7	11.0	21.6
After AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^{0,i}$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.083	65	-0.930	-6.9	15.3	60.1
A2	0.152	89	-0.001	-14.7	4.9	19.3
A3	0.211	73	-0.613	-19.6	5.2	20.5

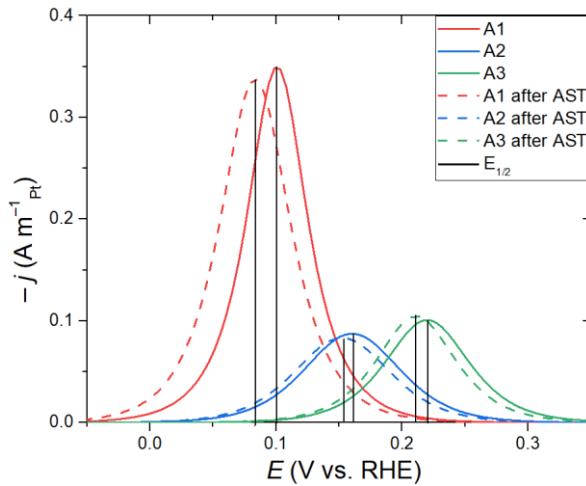


Figure S7. Hydrogen adsorption peaks of Pt²⁰/C before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA.

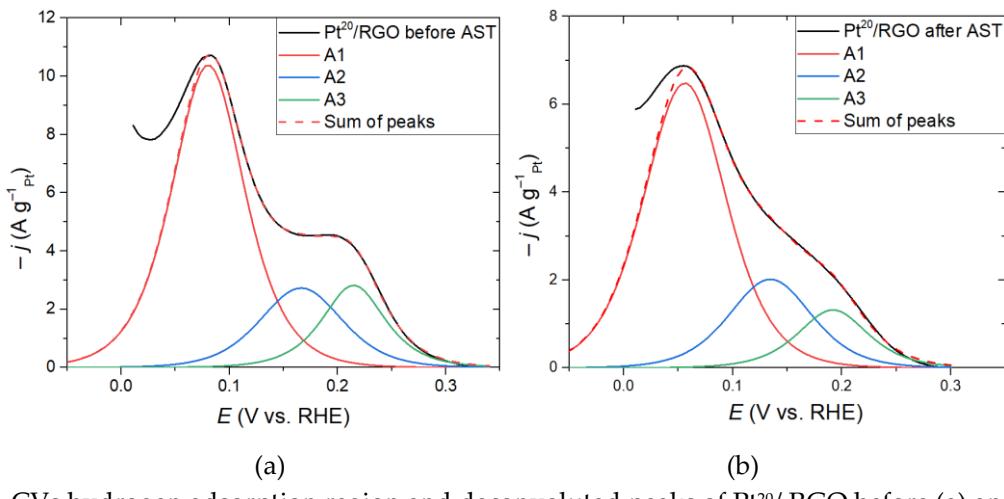


Figure S8. CVs hydrogen adsorption region and deconvoluted peaks of Pt²⁰/RGO before (a) and after 3000 AST cycles (b).

Table S4. Computed values of adsorption isotherm parameters of Pt²⁰/RGO.

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^{0,i}$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.080	79	-0.388	-7.3	22.6	65.3
A2	0.166	89	-0.004	-16.0	6.6	19.0
A3	0.215	68	-0.812	-19.7	5.4	15.7
After AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^{0,i}$, kJ mol ⁻¹	ESA_i , m ² g ⁻¹ Pt	P_i , %
A1	0.056	89	-0.009	-5.4	15.6	67.2
A2	0.135	89	-0.006	-13.0	4.9	20.9
A3	0.192	76	-0.551	-17.8	2.7	11.8

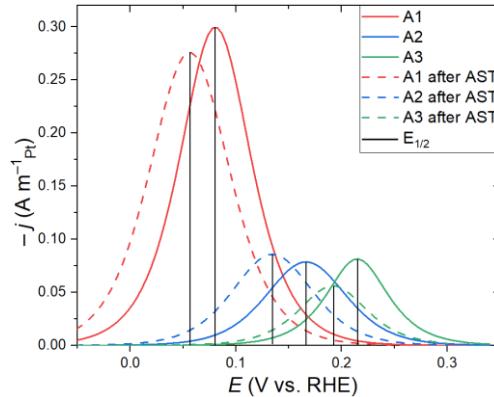


Figure S9. Hydrogen adsorption peaks of Pt²⁰/RGO before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA.

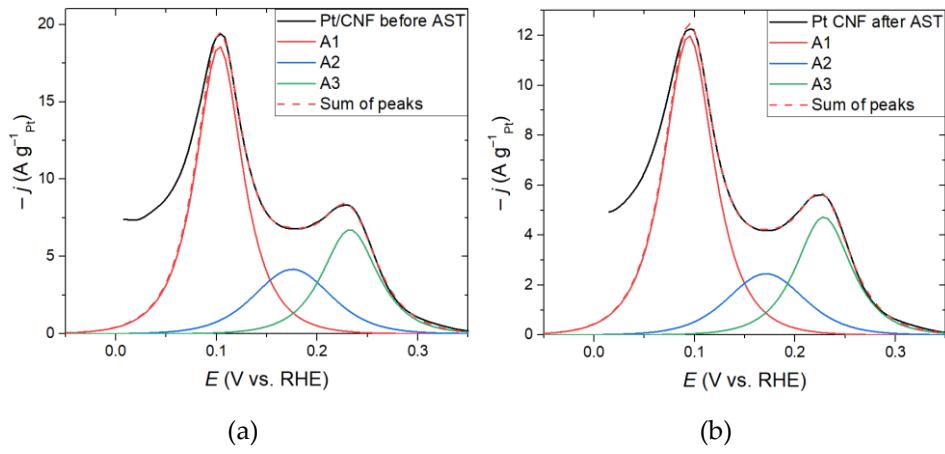


Figure S10. CVs hydrogen adsorption region and deconvoluted peaks of $\text{Pt}^{20}/\text{CNF}$ before (a) and after 3000 AST cycles (b).

Table S5. Computed values of adsorption isotherm parameters of $\text{Pt}^{20}/\text{CNF}$.

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol^{-1}	ESA_i , $\text{m}^2 \text{g}^{-1}\text{Pt}$	P_i , %
A1	0.103	54	-1.355	-8.3	29.7	57.0
A2	0.175	89	-0.001	-16.9	10.1	19.4
A3	0.233	64	-0.978	-21.2	12.3	23.6
After AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol^{-1}	ESA_i , $\text{m}^2 \text{g}^{-1}\text{Pt}$	P_i , %
A1	0.094	58	-1.201	-7.6	20.3	58.2
A2	0.171	89	-0.002	-16.5	5.9	17.0
A3	0.228	64	-0.975	-20.9	8.6	24.8

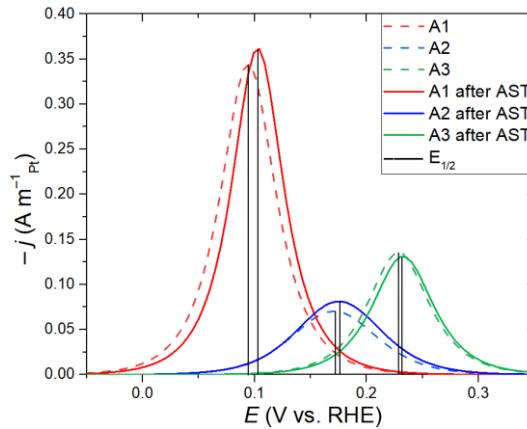


Figure S11. Hydrogen adsorption peaks of $\text{Pt}^{20}/\text{CNF}$ before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA.

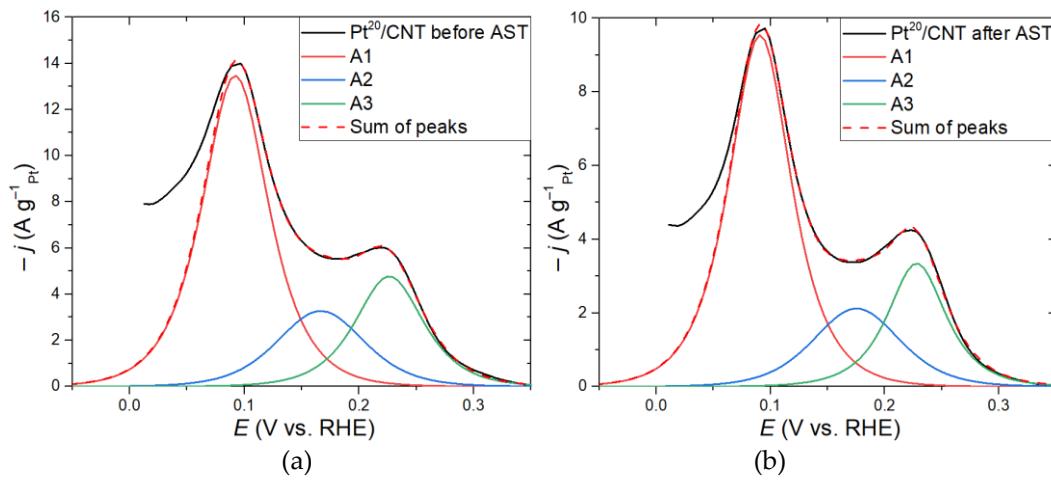


Figure S12. CVs hydrogen adsorption region and deconvoluted peaks of $\text{Pt}^{20}/\text{CNT}$ before (a) and after 3000 AST cycles (b).

Table S6. Computed values of adsorption isotherm parameters of $\text{Pt}^{20}/\text{CNT}$.

Before AST						
Peak	E_m , V	FWHM, mV	g	$\Delta G_{ads}^0 i$, kJ mol^{-1}	ESA_i , $\text{m}^2 \text{g}^{-1}\text{Pt}$	P_i , %
A1	0.092	68	-0.809	-7.9	25.9	60.0
A2	0.167	89	-0.002	-16.1	7.9	18.3
A3	0.226	70	-0.745	-20.9	9.4	21.7
After AST						
A1	0.091	64	-0.956	-7.6	17.5	61.7
A2	0.175	89	-0.003	-16.9	5.1	18.0
A3	0.228	60	-1.137	-20.6	5.8	20.3

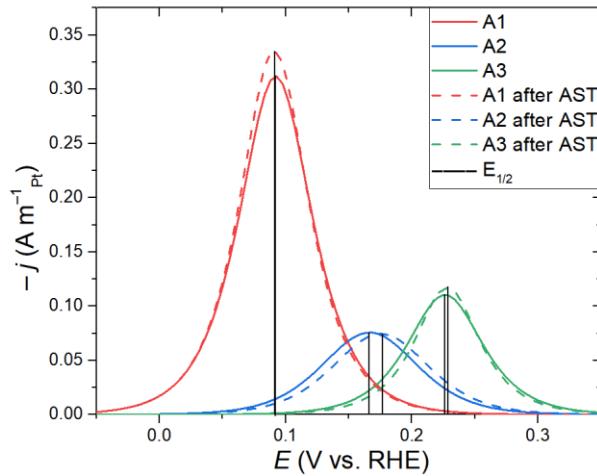


Figure S13. Hydrogen adsorption peaks of $\text{Pt}^{20}/\text{CNT}$ before and after 3000 AST cycles. The current density is normalized to the corresponding total ESA.