

**Ceria nanorods as highly stable free radical scavenger for highly
durable proton exchange membranes**

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Figure S1 is the typical hydrogen crossover curve for the Nafion/2%CeO₂ composite membranes (the thickness is 45μm). The black curve was tested after activating, and the red curve was tested immediately after open circuit voltage holding test without any recovery.

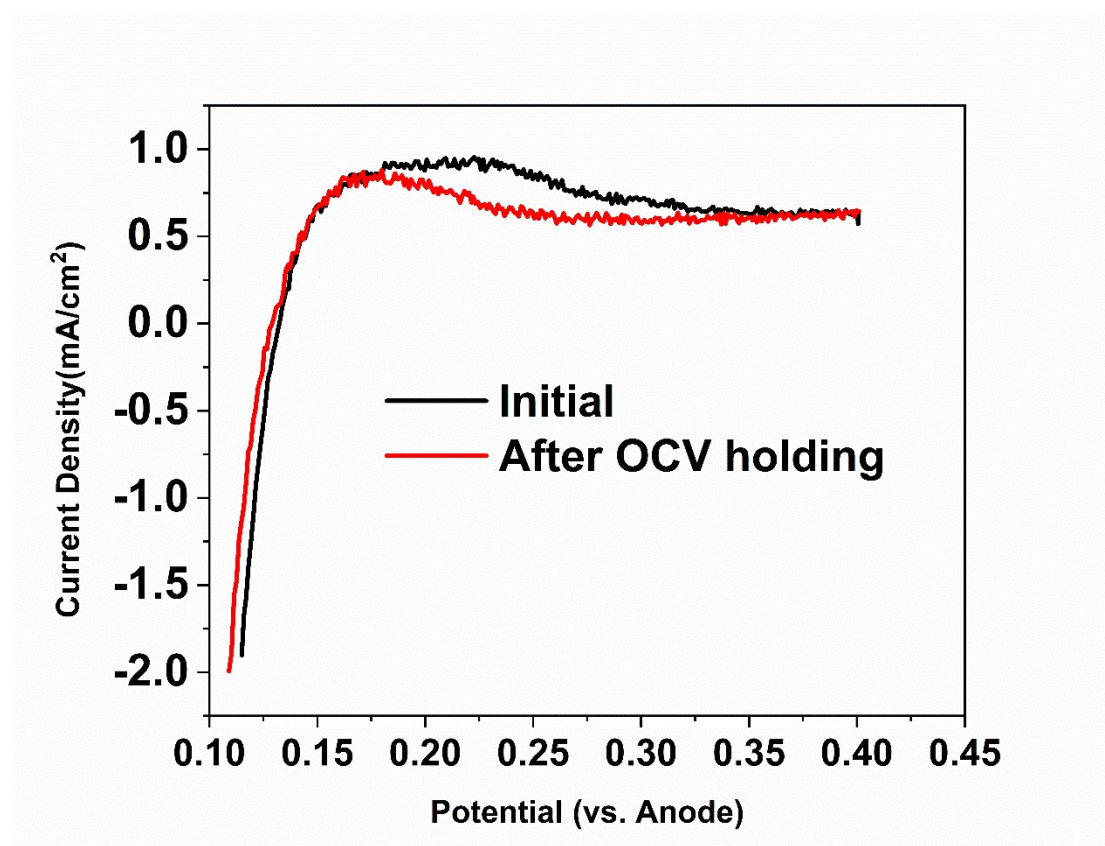


Figure S1. a) hydrogen crossover before open circuit voltage holding for Nafion/2%CeO₂ composite membranes; b) hydrogen crossover tested immediately after open circuit voltage test without recovery for Nafion/2%CeO₂ composite membranes.

Figure S2 is the adsorption desorption isotherms and pore diameter distribution for both ceria nanorods and commercial ceria nanoparticles.

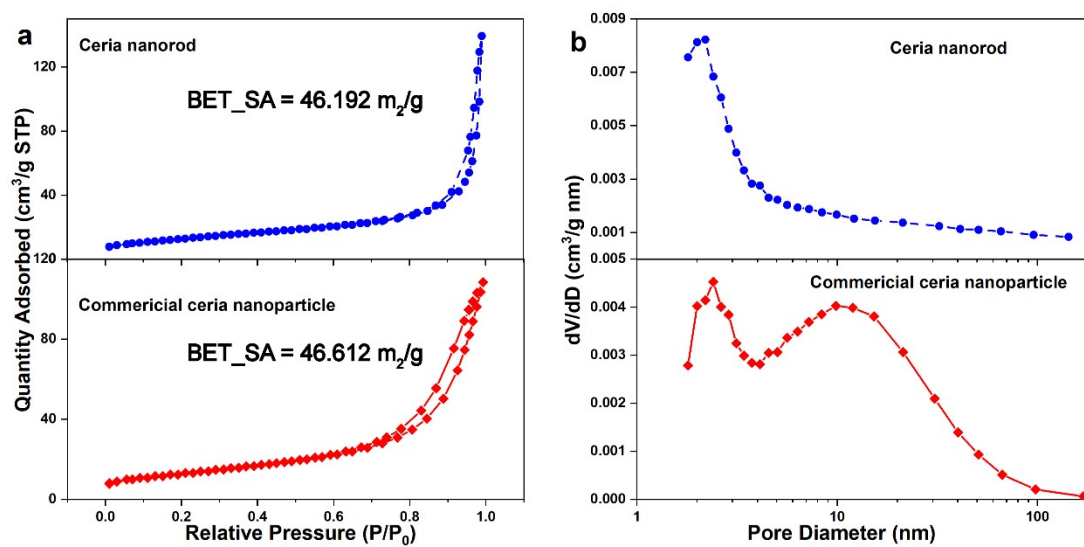


Figure S2. a) N_2 adsorption desorption isotherm and b) pore diameter distribution of ceria nanorods and ceria nanoparticles.

Table S1 is the peak area for each peak in Ce3d XPS spectrum.

Table S1. Peak area in Ce3d XPS spectrum.

Ce3d			Ceia nanoparticle			Ceia nanowrod		
	Spin orbit	Designation	BE (eV)	FWHM (eV)	area	BE (eV)	FWHM (eV)	area
Ce ³⁺	Ce3d5/2	V ₀	879.11	2.5	1127.98	879.16	2.94	1241.65
	Ce3d3/2	U ₀	897.25	2.87	897.75	897.35	2.93	860.65
	Ce3d5/2	V'	885.16	2.94	6298.39	885.03	2.91	6660.91
	Ce3d3/2	U'	903.29	2.98	3779.04	902.83	2.93	3988.64
Ce ⁴⁺	Ce3d5/2	V	882.18	2.71	15029.8 1	882	2.54	14483.1 7
	Ce3d3/2	U	900.66	2.4	8893.14	900.33	2.37	8630.21
	Ce3d5/2	V''	888.59	3.05	6958.26	888.51	2.93	6863.14
	Ce3d3/2	U''	907.23	3	4281	906.89	2.89	3810.69
	Ce3d5/2	V'''	898.03	2.4	12167.7 6	897.94	2.36	12328.9 1
	Ce3d3/2	U'''	916.4	2.52	8715.14	916.27	2.5	9060.03
n(Ce):n(O)			0.5232			0.5251		