

## Supplementary Information

# Hydrophobic Block-Structured PDMS/Pt-mesoporous silica Catalysts for Sustainable Water-Hydrogen Isotope Exchange

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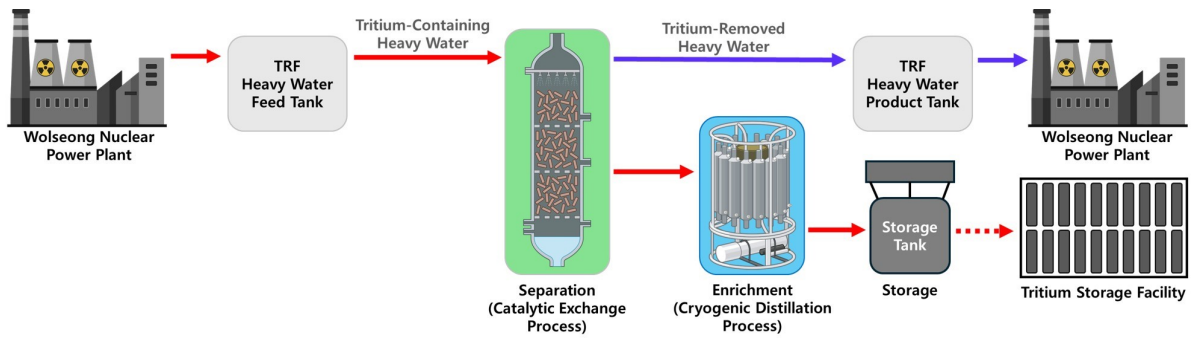
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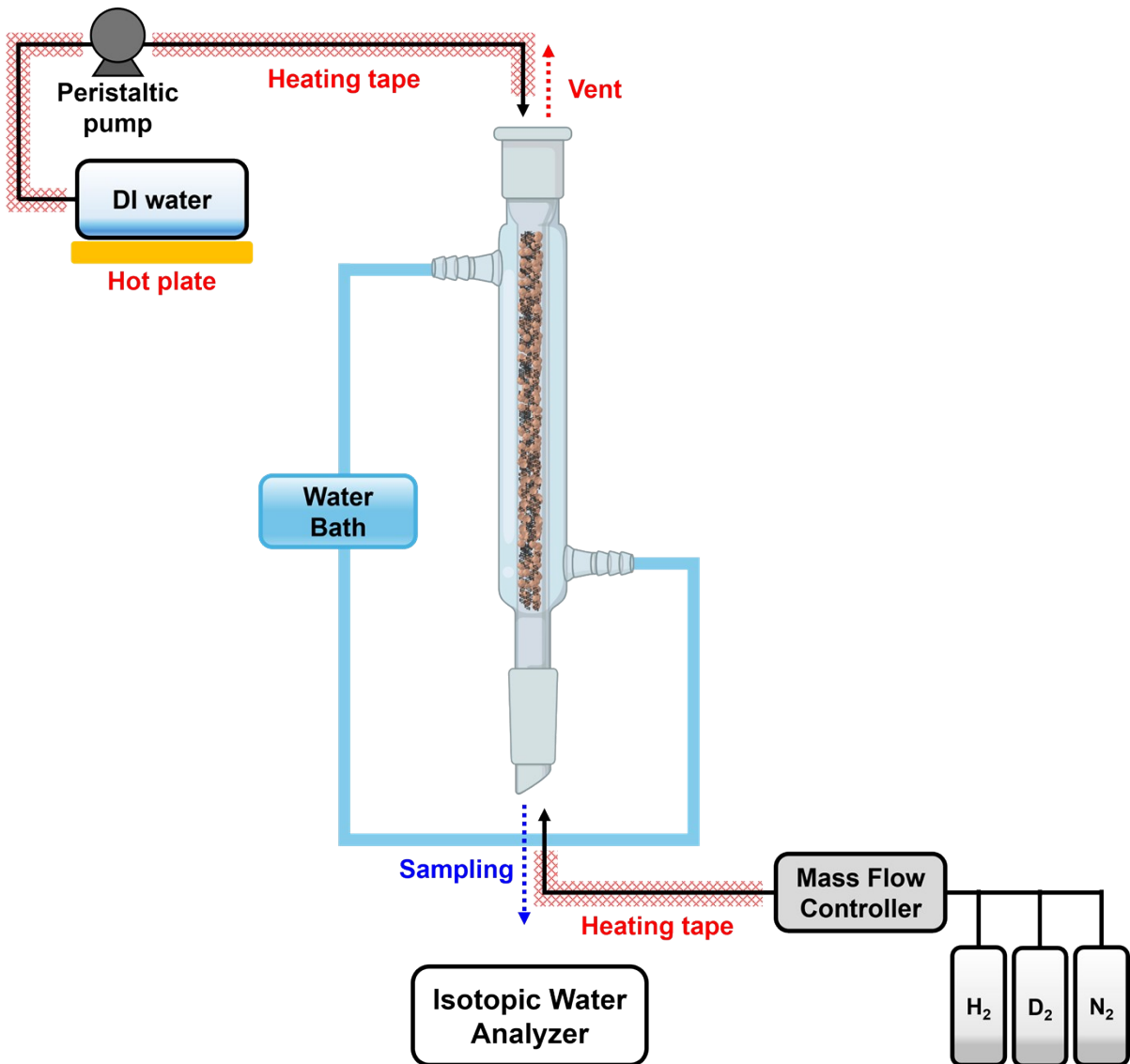
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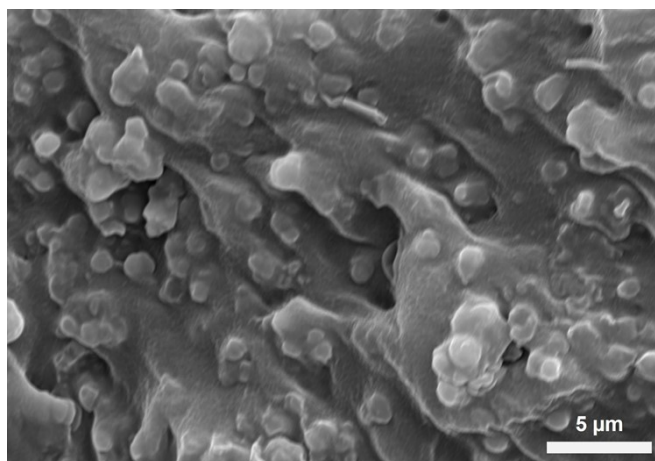
C.W. Park, E-mail: [chanwoo@kaeri.re.kr](mailto:chanwoo@kaeri.re.kr)



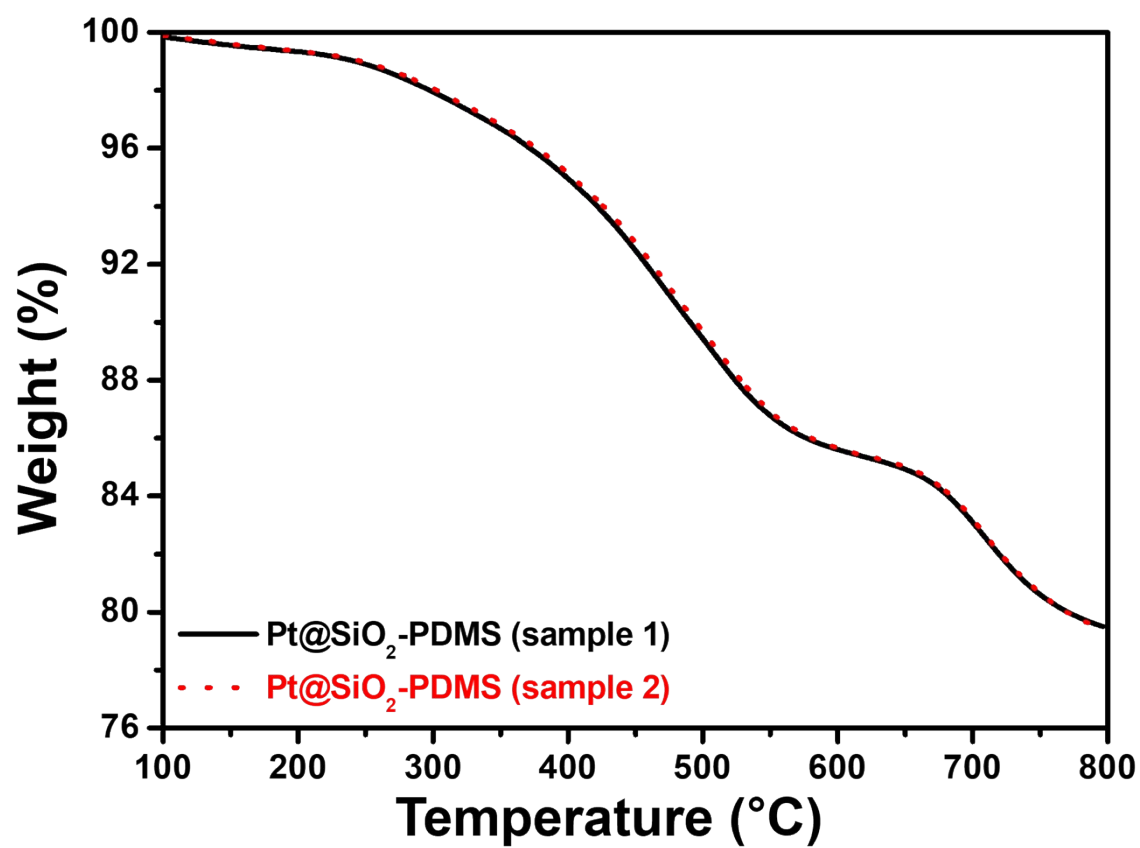
**Fig. S1** The scheme of the Tritium Removal Facility at Wolsong nuclear power plant.



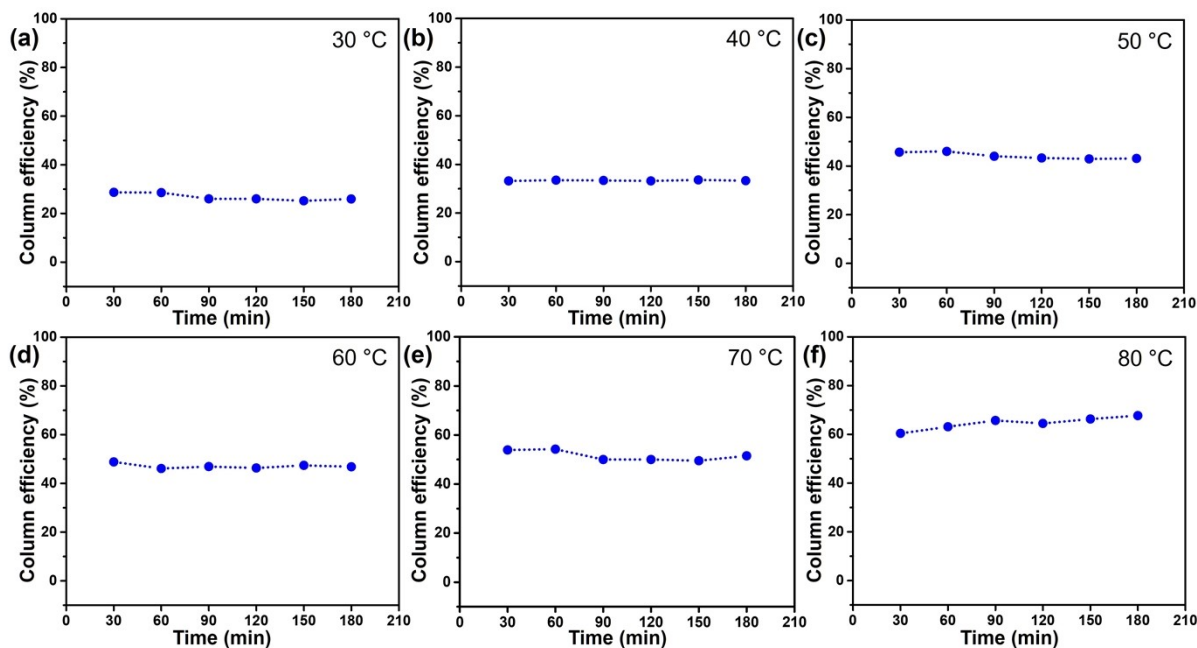
**Fig. S2** The schematic diagram of the lab made experimental setup for the LPCE process.



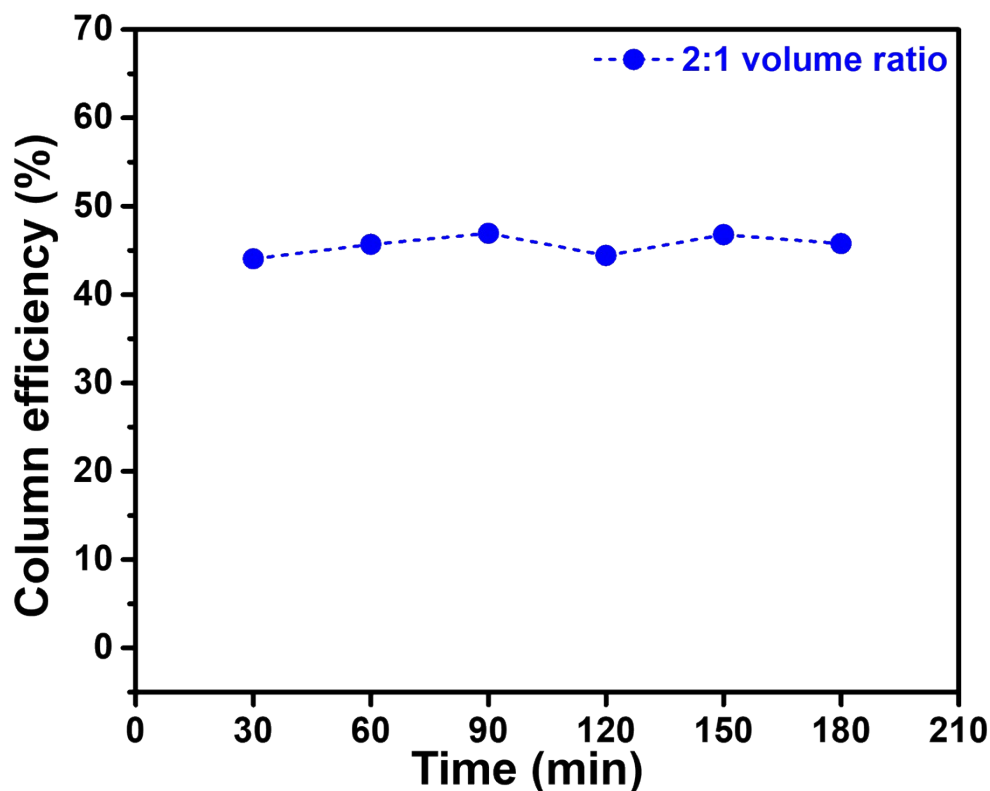
**Fig. S3** Cross-sectional SEM image of Pt@SiO<sub>2</sub>-PDMS.



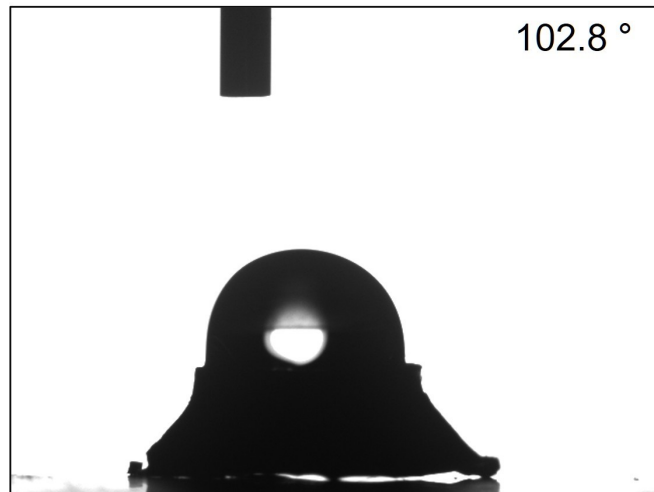
**Fig. S4** TGA curves of Pt@SiO<sub>2</sub>-PDMS sample by sample from different batch.



**Fig. S5** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 2:1 measured at temperatures of (a) 30, (b) 40, (c) 50, (d) 60, (e) 70 and (f) 80 °C.



**Fig. S6** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 2:1 measured every 30 min interval over 180 min at 60 °C. The column containing catalyst and Dixon rings was stored in a 65 °C oven overnight for regeneration after 14 days of LPCE operation in Fig. 11.



**Fig. S7** The WCA of Pt@SiO<sub>2</sub>-PDMS measured after the long-term LPCE test.

**Table S1** Column efficiency (%) of PDMS, SiO<sub>2</sub>-PDMS and Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 1:4 measured every 30 min interval over 180 min at 60 °C.

Time (min)	PDMS	SiO <sub>2</sub> -PDMS	Pt@SiO <sub>2</sub> -PDMS
30	-0.3 <sup>a</sup>	0	21.4
60	0	0.2	21.3
90	-0.1 <sup>a</sup>	0.5	23.0
120	0	-0.2 <sup>a</sup>	22.6
150	0.2	-0.4 <sup>a</sup>	22.5
180	0.1	-0.3 <sup>a</sup>	19.3

<sup>a</sup>negative value indicates the mass transfer in the wrong direction, thereby D transfers opposite to what equilibrium predicts.

**Table S2** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 1:4, 1:1 and 2:1 measured every 30 min interval over 180 min at 60 °C.

Time (min)	1:4 volume ratio	1:1 volume ratio	2:1 volume ratio
30	21.4	35.5	46.1
60	21.3	37.7	46.9
90	23.0	36.2	46.3
120	22.6	37.1	47.4
150	22.5	36.6	46.8
180	19.3	35.5	47.0

**Table S3** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 2:1 measured every 30 min interval over 180 min under temperate ranging from 30 to 80 °C.

Time (min)	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
30	28.0	33.2	45.7	<b>48.8</b>	53.9	60.4
60	<b>28.7</b>	33.5	<b>46.0</b>	46.1	<b>54.2</b>	63.1
90	28.6	33.4	44.0	46.9	50.0	65.7
120	26.0	33.2	43.3	46.3	50.0	64.5
150	26.0	<b>33.6</b>	42.9	47.4	49.5	66.3
180	25.2	33.3	43.1	46.8	51.5	<b>67.7</b>

**Table S4** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 2:1 measured for 14 days at 80 °C.

Time (min)	Column efficiency (%)	Time (day)	Column efficiency (%)	Time (day)	Column efficiency (%)
15	60.4	1	62.6	11	63.6
30	63.1	2	65.3	12	69.3
60	65.7	3	68.7	13	63.3
90	64.5	4	64.4	14	64.6
120	66.3	5	64.0		
150	67.7	6	66.9		
180	67.0	7	66.7		
360	60.4	8	65.0		-
720	62.9	9	62.7		
1080	64.6	10	67.4		

**Table S5** Column efficiency (%) of the Pt@SiO<sub>2</sub>-PDMS randomly packed with Dixon rings in a volume ratio of 2:1 measured every 30 min interval over 180 min at 60 °C for recyclability test after 14 days of LPCE operation and subsequent regeneration.

Time (min)	Column efficiency (%)
30	44.0
60	45.7
90	46.9
120	44.4
150	46.8
180	45.8

**Table S6** H<sub>2</sub> chemisorption results of Pt@SiO<sub>2</sub>-PDMS after the long-term LPCE test.

Metal dispersion (%)	Metallic surface area (m <sup>2</sup> g <sup>-1</sup> metal)	Particle size (nm)
3.1	7.6	36.7