Supporting Information

Real-time tunable hydrogen generation from hydrolysis of borohydride using 3D magnetic catalyst

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Materials

Cobalt sulfate heptahydrate ($CoSO_4 \cdot 7H_2O$), Nickel sulfate hexahydrate ($NiSO_4 \cdot 6H_2O$), Sodium molybdate dihydrate ($Na_2MoO_4 \cdot 2H_2O$), Sodium sulfate anhydrous (Na_2SO_4), Sodium succinate ($C_4H_4Na_2O_4$), Sodium Hydroxide (NaOH), ethanol (C_2H_5OH), Sodium borohydride ($NaBH_4$), Borane dimethylamine complex (DMAB) are all analytical grade and used without further purification. Pure $Me_4NB_3H_8$ was prepared according to published method. Melamine foam (MF) and Polyurethane foam (PU) were purchased from commercial company.

Calculations

The effect of temperature on the reaction rate of the synthesized catalysts was analyzed by using the Arrhenius equation as follows:

$\ln k = \ln A - Ea/RT$

Where k (mL min^{-1} g^{-1}) is the rate coefficient, A (mL min^{-1} g^{-1}) is a constant, Ea (kJ

mol^{-1}) is the activation energy, R (8.314 J mol^{-1} K^{-1}) is the universal gas constant, and T (K) is the temperature.

Table S1. ICP-AES result of Co-Mo-O-B/MF catalyst

ICP-AES result	
Co (wt. %)	70.21
Mo (wt. %)	2.1
B (wt. %)	0.5
Co/Mo (atom)	54.66
Co/B (atom)	25.56

Table S2. SEM-EDS elemental analysis results of Co-Mo-O-B/MF catalyst

E1	AN	Series	unn.C wt. %	norm.C wt. %	Atom.C at. %	Error %
Co	27	L-series	82.49	82.5	65.42	26.9
O	8	K-series	11.33	11.33	30.13	4.5
B	5	K-series	0.59	0.59	2.55	1.1
Mo	42	L-series	2.31	2.3	1.12	0.1
Au	79	M-series	3.28	3.28	0.78	0.7
Total			100	100	100	

Table S3. EXAFS fitting parameters at the Co K-edge for various samples (S_0^2=0.8 for Co).

Sample	Shell	*CN*[a]	*R*(Å)[b]	σ^2(Å^2)[c]	ΔE_0(eV)[d]
Co-Mo-O-B	Co-Co	2.39±0.82	2.44±0.03	0.0086±0.0039	2.187±3.8
	Co-Mo	0.29±0.49	2.67±0.15	0.0086±0.0039	2.187±3.8

[a]*CN*, coordination number; [b]*R*, distance between absorber and backscatter atoms; [c]σ^2, Debye-Waller factor to account for both thermal and structural disorders; [d]ΔE_0, inner potential correction. S_0^2 was fixed to 0.8 for Co, according to the experimental EXAFS fit of Co foil by fixing CN as the known crystallographic value.

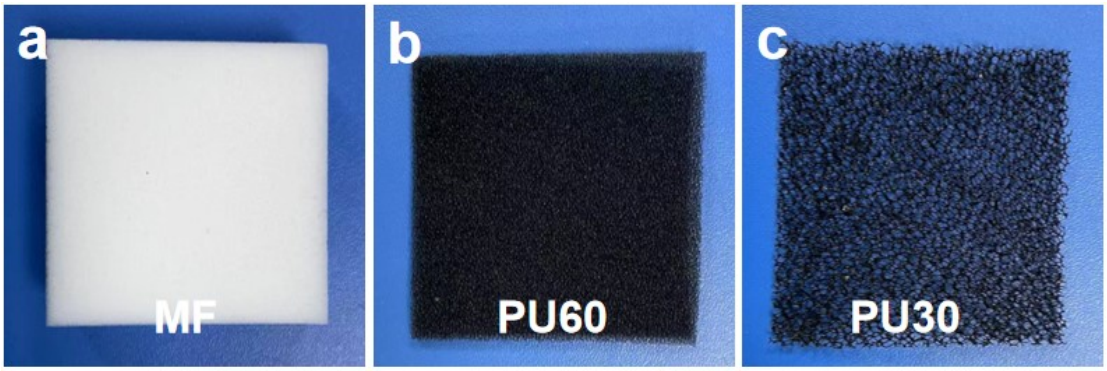

Fig. S1. Optical photographs of melamine foam (MF) (a) and polyurethane foam (PU) with pore sizes of 60 ppi (b) and 30 ppi (c).

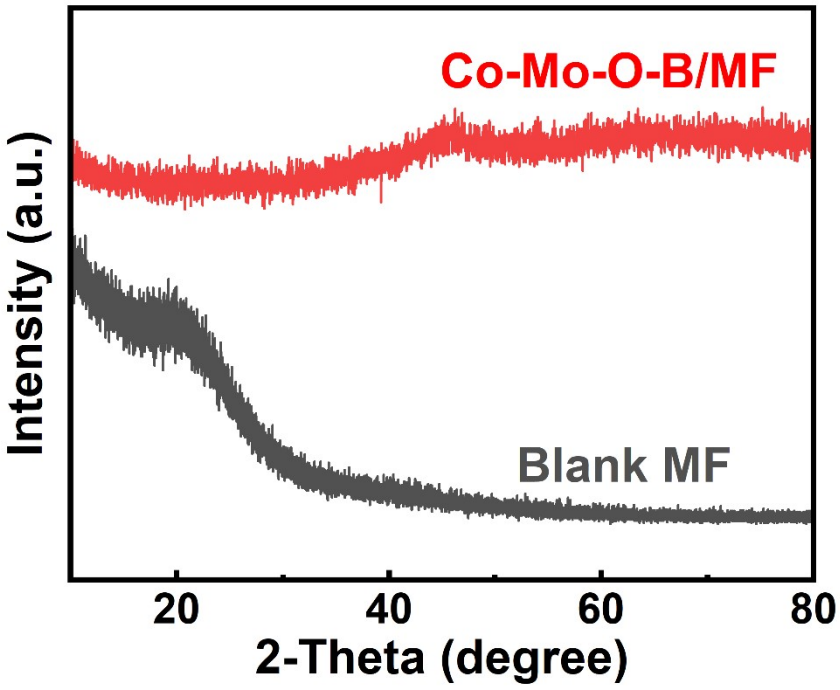

Fig. S2. X-ray diffraction patterns of Co-Mo-O-B/MF and Blank MF.

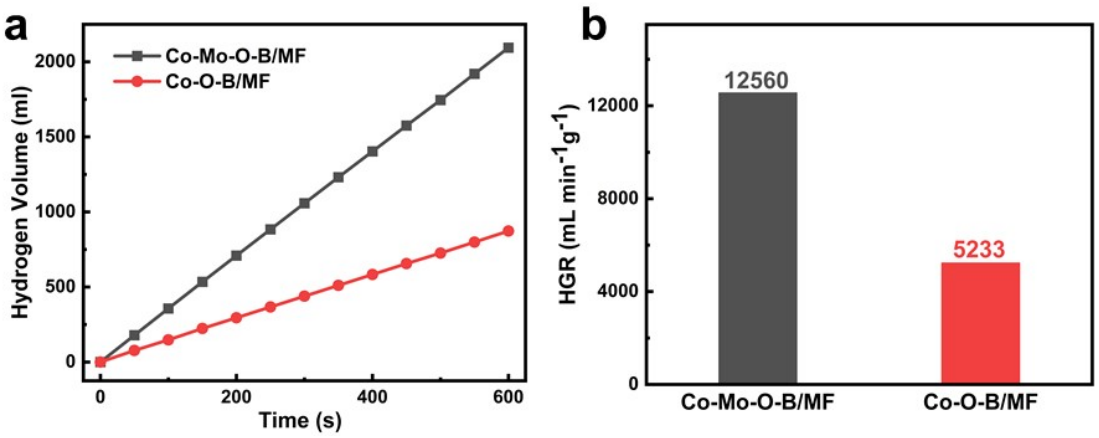

Fig. S3 (a) Plots of time versus volume of generated H_2 from $NaBH_4$ alkaline solution catalyzed by Co-Mo-O-B/MF and Co-O-B/MF catalysts and (b) their corresponding HGR (10 wt.% $NaBH_4$ and 7 wt.% NaOH solution at 30 °C). Co-O-B/MF catalyst without Mo was prepared in the similar way as Co-Mo-O-B/MF except that Na_2MoO_4 was removed from the corresponding electroless plating bath.

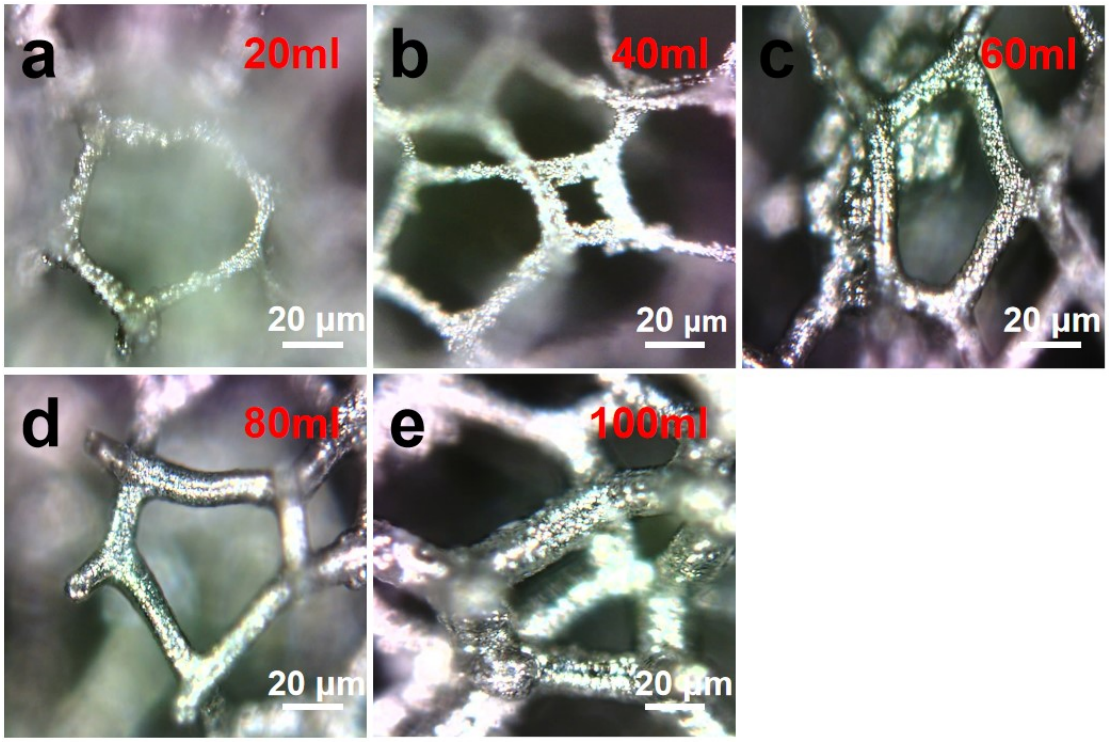

Fig. S4. Optical micrographs of Co-Mo-O-B/MF (a), Co-Mo-O-B/MF-40 (b), Co-Mo-O-B/MF-60 (c), Co-Mo-O-B/MF-80 (d), Co-Mo-O-B/MF-100 (e) prepared by increasing the volume of electroless plating bath.

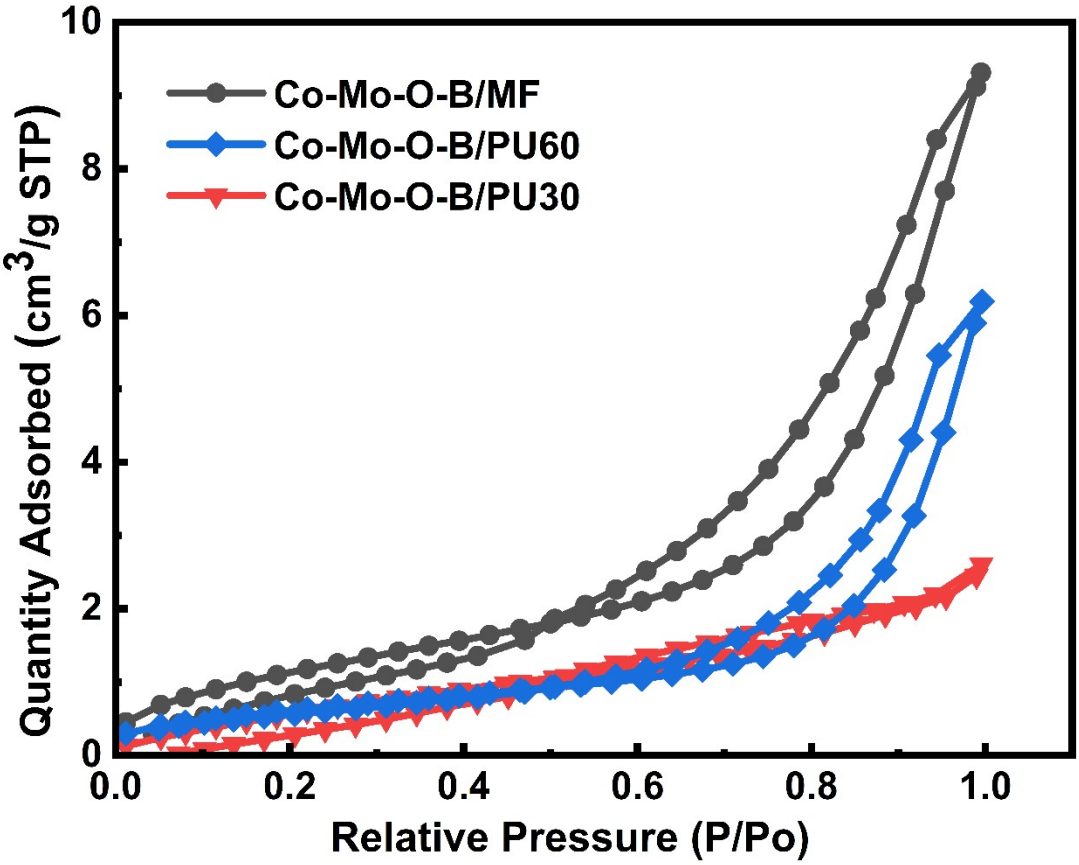

Fig. S5. Isotherm linear plots of Co-Mo-O-B catalysts with different substrates.

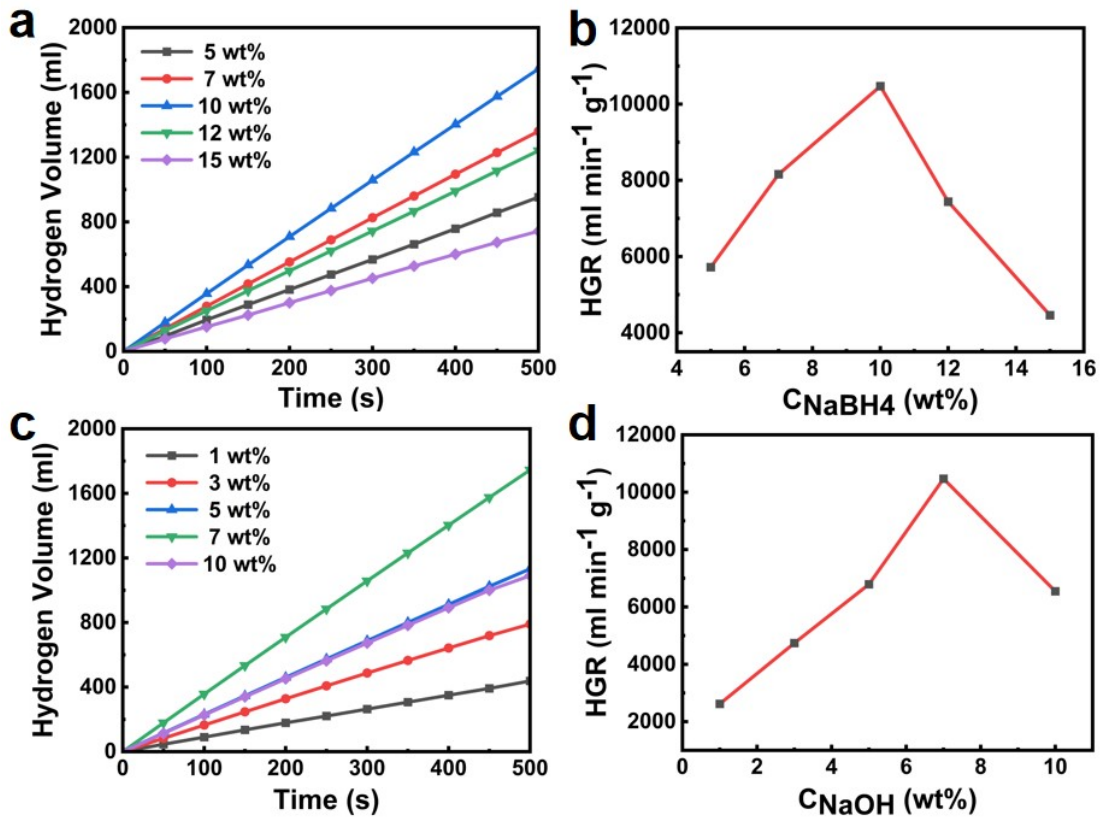

Fig. S6. (a) H_2 evolution by Co-Mo-O-B/MF catalysts with different concentrations of $NaBH_4$ and fixed NaOH concentrations (7 wt.% at 30 °C) and (b) the plot of HGR versus concentration of $NaBH_4$. (c) H_2 evolution by Co-Mo-O-B/MF catalysts with different concentrations of NaOH and fixed $NaBH_4$ concentrations (10 wt.% at 30 °C) and (d) the plot of HGR versus concentration of NaOH.

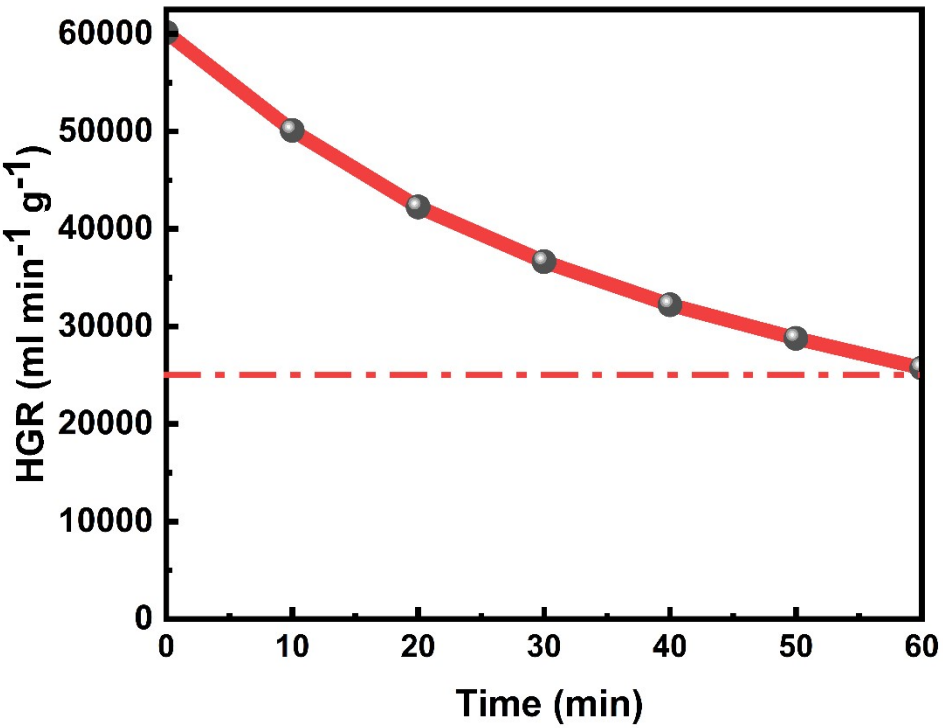

Fig. S7. (a) Plot of HGR vs continuous reaction time of the Co-Mo-O-B/MF catalyst (10 wt.% $NaBH_4$ and 7 wt.% NaOH solution at 60 °C).