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SUPPLEMENTARY MATERIAL TO

Ruthenium(III)-monosubstituted Keggin-type polyoxotungstate: Synthesis, characterization and application in the catalytic methanation of carbon dioxide

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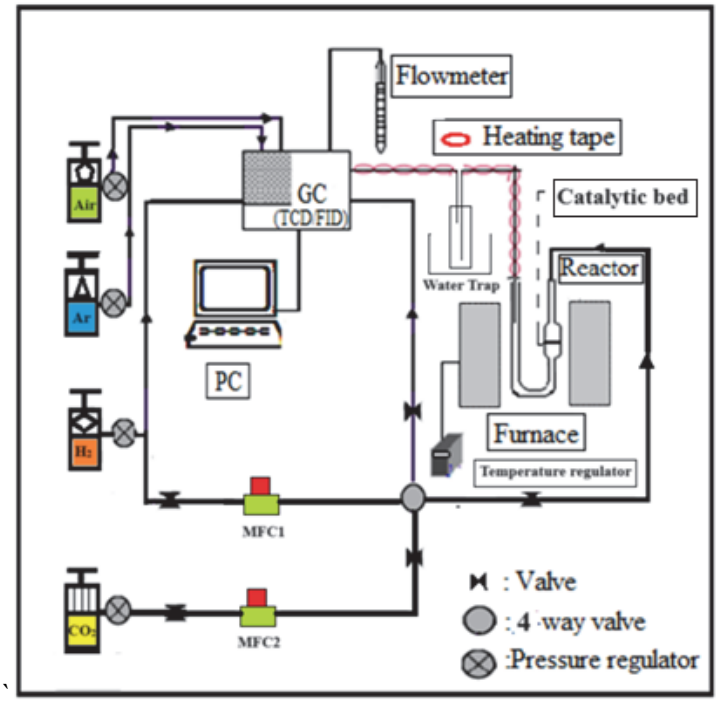

Fig. S-1. Schematic diagram of the experimental setup for methanation of CO_2

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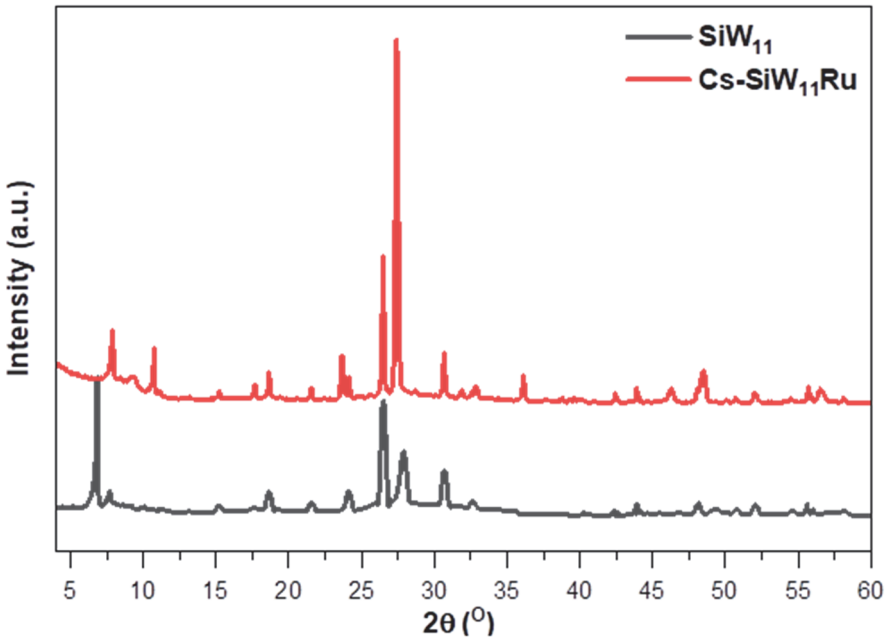

Fig. S-2. X-ray diffraction (XRD) patterns of $K_8(\alpha\text{-}SiW_{11}O_{39})$ (black) and $Cs_5[SiW_{11}O_{39}Ru^{III}(H_2O)]$ (red).

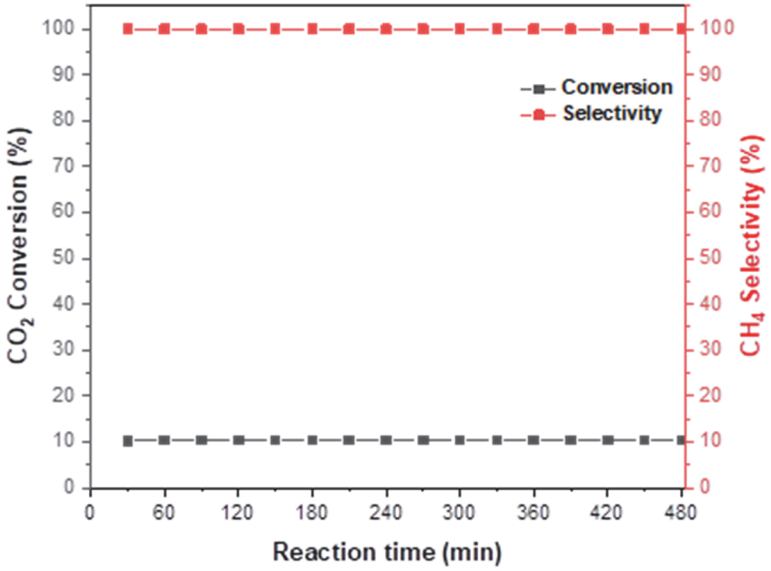

Fig. S-3. Stability of the prepared Cs-$SiW_{11}Ru$ catalyst for CO_2 methanation. Reaction conditions: flow rate, 1 L/h; H_2/CO_2, 4; reaction temperature, 300 °C; and atmospheric pressure.

TABLE S-I. Effect of the reaction temperature on CO_2 methanation over the Cs-$SiW_{11}Ru$ catalyst

Catalyst	T (°C)	Conversion (%)	Selectivity of products (%)	
			CH_4	CO
Cs-$SiW_{11}Ru$	200	0.4	100	0
	250	2	100	0
	300	10	100	0
	350	22	95.31	4.69
	400	29	70.10	29.90
	450	59	42.27	57.73

TABLE S-II. Effect of the total flow rate on the reactivity of the Cs-$SiW_{11}Ru$ catalyst

Flow rate (l/h)	T (°C)	Conversion (%)	Selectivity of products (%)	
			CH_4	CO
1	300	10	100	0
1.5		06	88.8	11.2
2		03	85.3	14.7

TABLE S-III. Effect of the H_2/CO_2 ratio on the reactivity of the Cs-$SiW_{11}Ru$ catalyst

T (°C)	Flow rate (L/h)	H_2/CO_2 ratio	Conversion (%)	Selectivity of products (%)	
				CH_4	CO
300	1	1	04	98.5	1.5
		2	06.5	99	01
		4	10	100	0