

Supporting information

Partial oxidation of methane to formaldehyde over cupper-molybdenum complex oxide catalysts

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Table S1 Methane oxidation over various Cu-based complex oxide (Cu-MO_x) catalysts (M = V, Cr, Mn, Fe, Mo, Ta, Cu/M = 1/1 as mole ratio). Catalyst = 0.050 g, flow rate = 70 mL min⁻¹, $P(\text{CH}_4) = 14.5 \text{ kPa}$, $P(\text{O}_2) = 14.5 \text{ kPa}$, $P(\text{H}_2\text{O}) = 14.5 \text{ kPa}$. These reactants were diluted with He.

catalyst	temp. [°C]	CH ₄ Conversion [%]	selectivity [%]				
			HCHO	CO	CO ₂	C ₂ H ₆	C ₂ H ₄
Cu-VO _x	650	0.7	18	7	75	trace	0
	700	2.5	21	13	66	trace	trace
Cu-CrO _x	600	3.6	1	0	99	0	0
	650	8.3	1	0	99	0	0
Cu-MnO _x	600	2.2	1	0	99	0	0
	650	2.9	5	trace	95	0	0
Cu-FeO _x	600	2.6	trace	0	100	0	0
	650	4.1	trace	0	100	0	0
Cu-MoO _x	650	0.3	100	0	0	0	0
	700	1.0	78	17	5	0	0
Cu-TaO _x	550	0.8	2	0	98	0	0
	600	5.5	trace	0	100	0	0

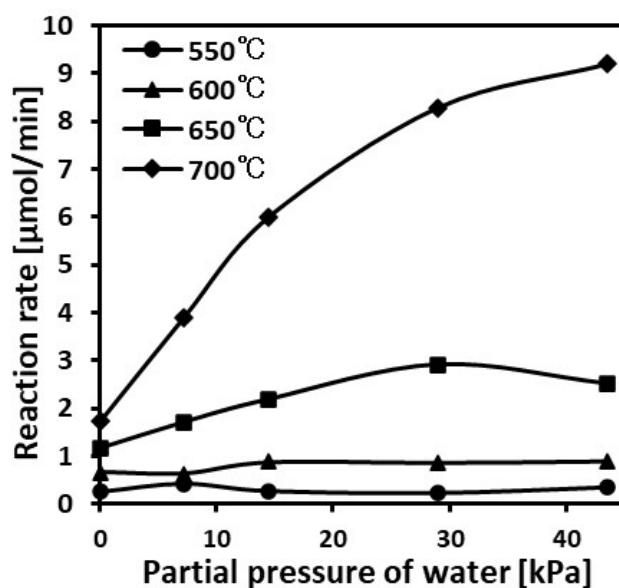


Fig. S1 Change of the oxidation rate of methane with partial pressures of water in the oxidation of methane over Cu-MoO_x (65%) catalysts. Catalyst = 0.050 g, flow rate = 70 mL min⁻¹, $P(\text{CH}_4) = 14.5 \text{ kPa}$, $P(\text{O}_2) = 14.5 \text{ kPa}$. These reactants were diluted with He.

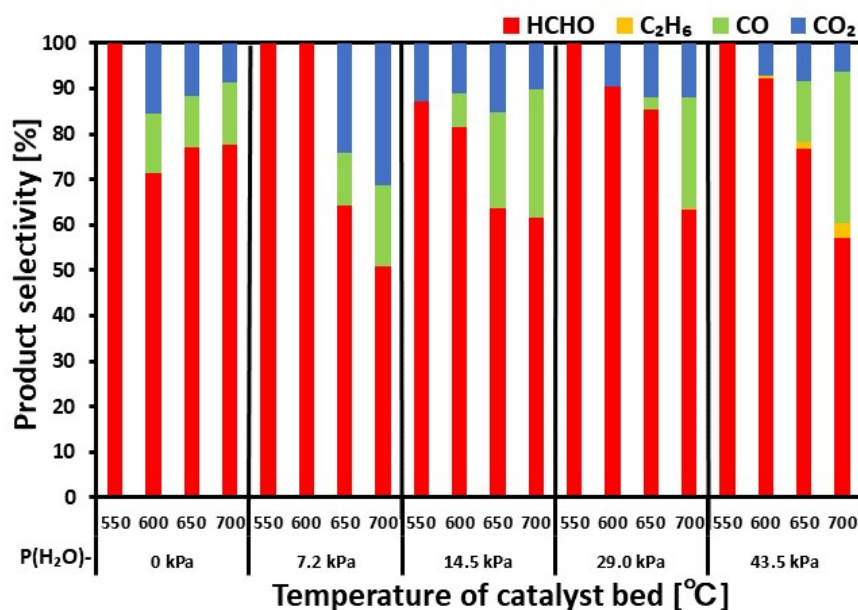


Fig. S2 Product selectivity at each temperature in the oxidation of methane over Cu-MoO_x (65%) catalysts with different partial pressure of water. Catalyst = 0.050 g, flow rate = 70 mL min⁻¹, $P(\text{CH}_4) = 14.5 \text{ kPa}$, $P(\text{O}_2) = 14.5 \text{ kPa}$. These reactants were diluted with He.

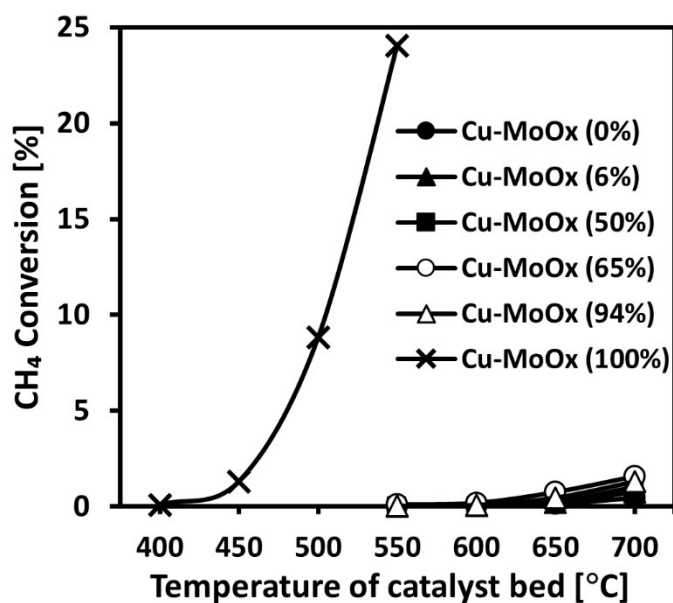


Fig. S3 Change of methane conversion against reaction temperature in the oxidation of methane over Cu-MoO_x catalysts with different Cu loadings. Catalyst = 0.050 g, flow rate = 70 mL min⁻¹, $P(\text{CH}_4) = 14.5 \text{ kPa}$, $P(\text{O}_2) = 14.5 \text{ kPa}$, $P(\text{H}_2\text{O}) = 14.5 \text{ kPa}$. These reactants were diluted with He.

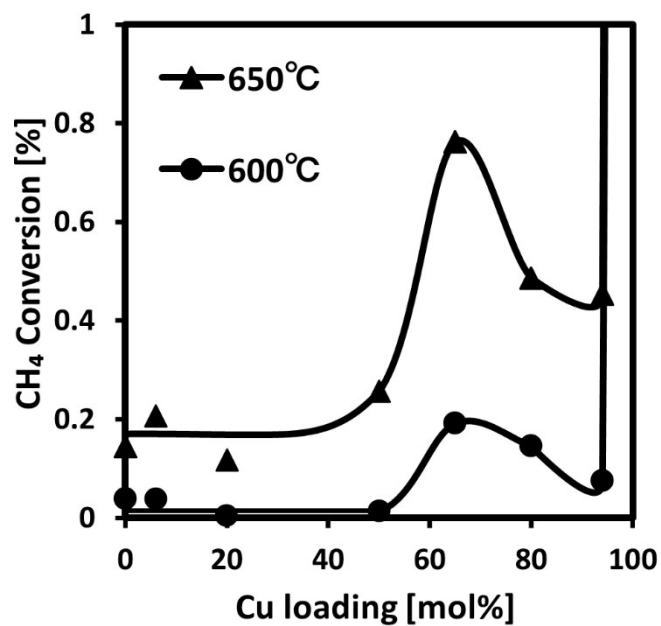


Fig. S4 Change of methane conversion with Cu loading in the Cu-MoO_x catalysts in the oxidation of methane in the presence of water vapor at 600 and 650°C. Catalyst = 0.050 g, flow rate = 70 mL min⁻¹, $P(\text{CH}_4) = 14.5$ kPa, $P(\text{O}_2) = 14.5$ kPa, $P(\text{H}_2\text{O}) = 14.5$ kPa. These reactants were diluted with He.