Electronic Supplementary Information (ESI)

Active and durable copper phosphate catalysts dispersed with metal oxide additives for the methane oxidation with oxygen into formaldehyde

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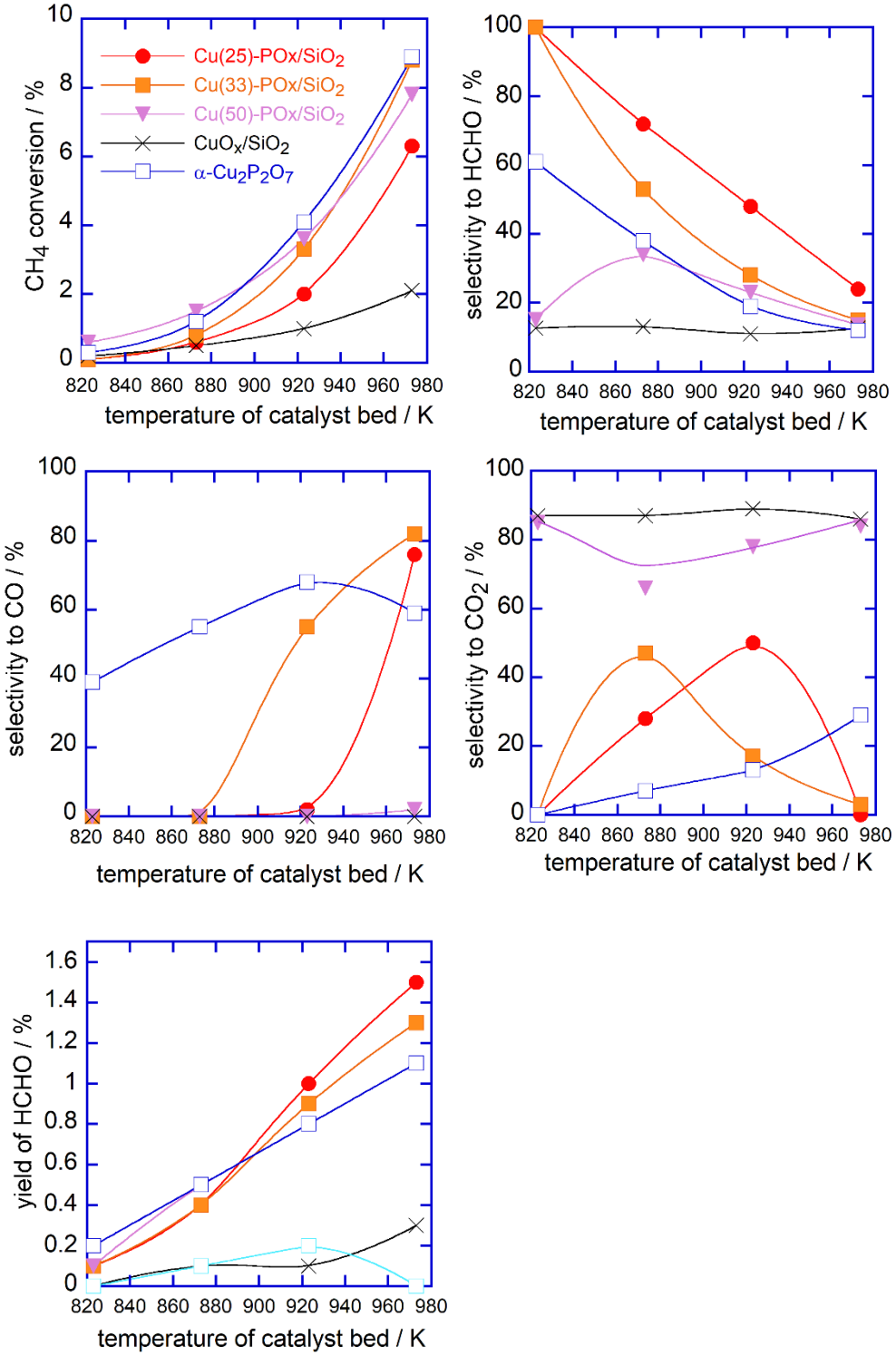

Figure S1 Change of methane conversion, selectivity to HCHO, CO and CO_2 and yield of HCHO as a function of temperatures of the catalyst bed in the methane oxidation over CuPOx/SiO_2 catalysts.

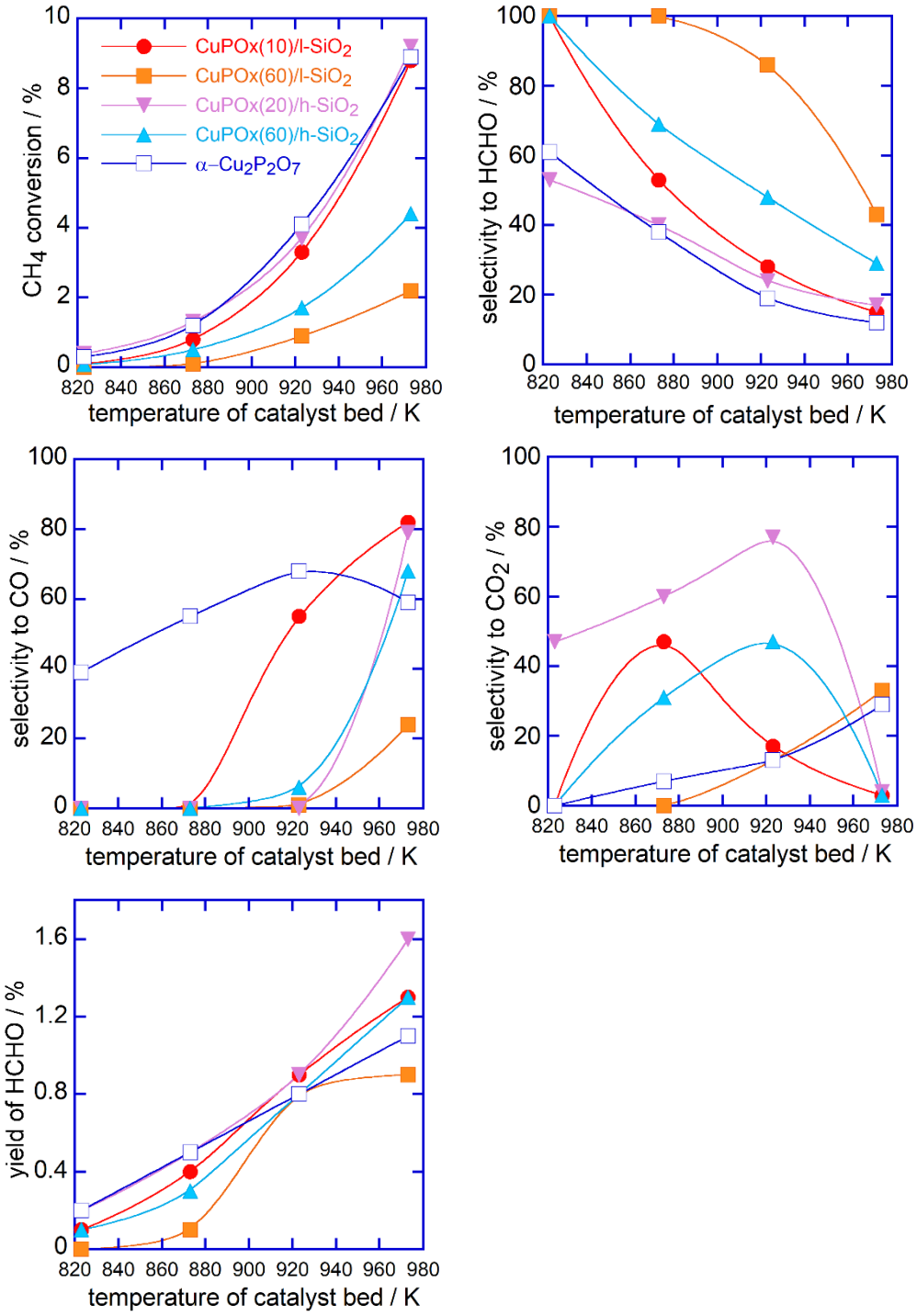

Figure S2 Change of methane conversion, selectivity to HCHO, CO and CO_2 and yield of HCHO as a function of temperatures of the catalyst bed in the methane oxidation over CuPOx/SiO_2 catalysts.

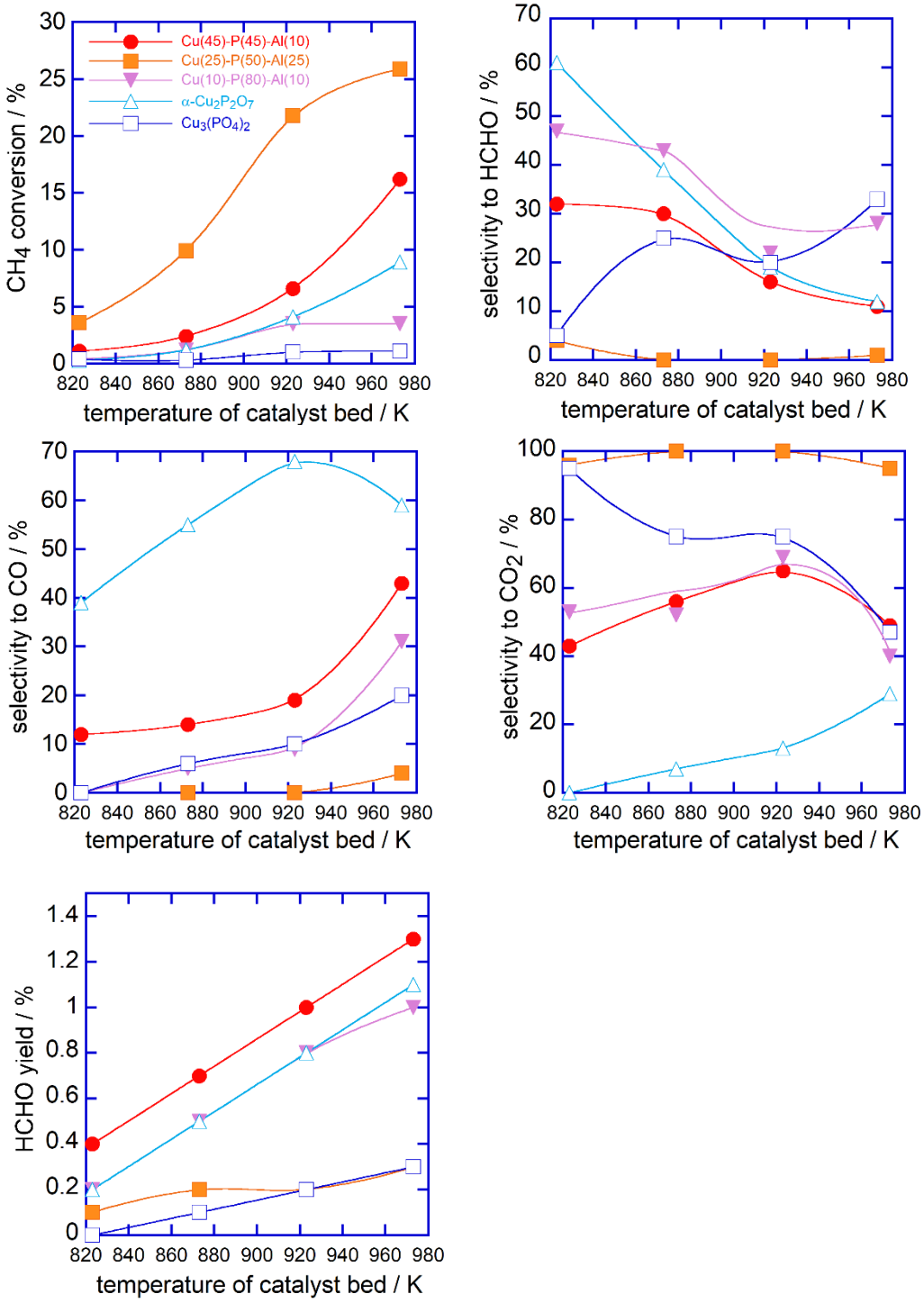

Figure S3 Change of methane conversion, selectivity to HCHO, CO and CO_2 and yield of HCHO as a function of temperatures of the catalyst bed in the methane oxidation over AlO_x-$CuPO_x$ catalysts.

Table S1 Methane oxidation over $CuPO_x$ catalysts modified with different metal oxides

Additive	Temp. [K]	Conversion [%]	Selectivity[%]			HCHO yield[%]
			HCHO	CO	CO_2	
None	873	1.2	38	55	7	0.5
	923	4.1	19	68	13	0.8
MgOx	873	2.7	10	11	79	0.3
	923	2.2	27	46	27	0.6
AlOx	873	2.4	30	14	56	0.7
	923	6.6	16	19	65	1.0
CrOx	873	1.0	43	46	11	0.4
	923	2.6	28	67	5	0.7
MnOx	873	1.8	22	46	32	0.4
	923	3.2	20	32	43	0.6
SrOx	873	0.6	28	19	53	0.2
	923	2.3	17	20	63	0.4

Table S2 Methane oxidation over AlO_x-$CuPO_x$ catalysts

Catalyst	Temp.	Conversion	Selectivity [%]			HCHO yield[%]
	[K]	[%]	HCHO	CO	CO_2	
Cu(10)-P(45)-Al(45)	873	20.0	0	1	99	0.07
	923	46.0	0	1	99	0.08
Cu(50)-P(25)-Al(25)	873	4.1	2	1	97	0.08
	923	12.3	1	3	96	0.2
Cu(80)-P(10)-Al(10)	873	1.7	5	4	92	0.08
	923	5.6	3	4	94	0.1
Cu(25)-P(25)-Al(50)	873	4.6	0	0	100	0.01
	923	5.8	0	0	100	0.02
Cu(10)-P(10)-Al(80)	873	2.4	2	5	93	0.02
	923	4.4	2	7	91	0.04
Cu(45)-P(10)-Al(45)	873	10.6	1	0	99	0.06
	923	20.5	0	0	99	0.06