Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

High-Throughput Screening and Characterization of Novel Zeolitic Imidazolate Framework Gels

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Experimental

Stability testing

To investigate the chemical stability of the prepared ZIF-zni films, the chemical stability of ZIF-zni crystal powder prepared using the above-mentioned method was determined. The test was performed by immersing powder samples into water, methanol, and a sodium hydroxide solution (0.3 M) used as solvents at 27 °C and the boiling points (water and sodium hydroxide solution: 100 °C; methanol: 65 °C) for up to 7 days.

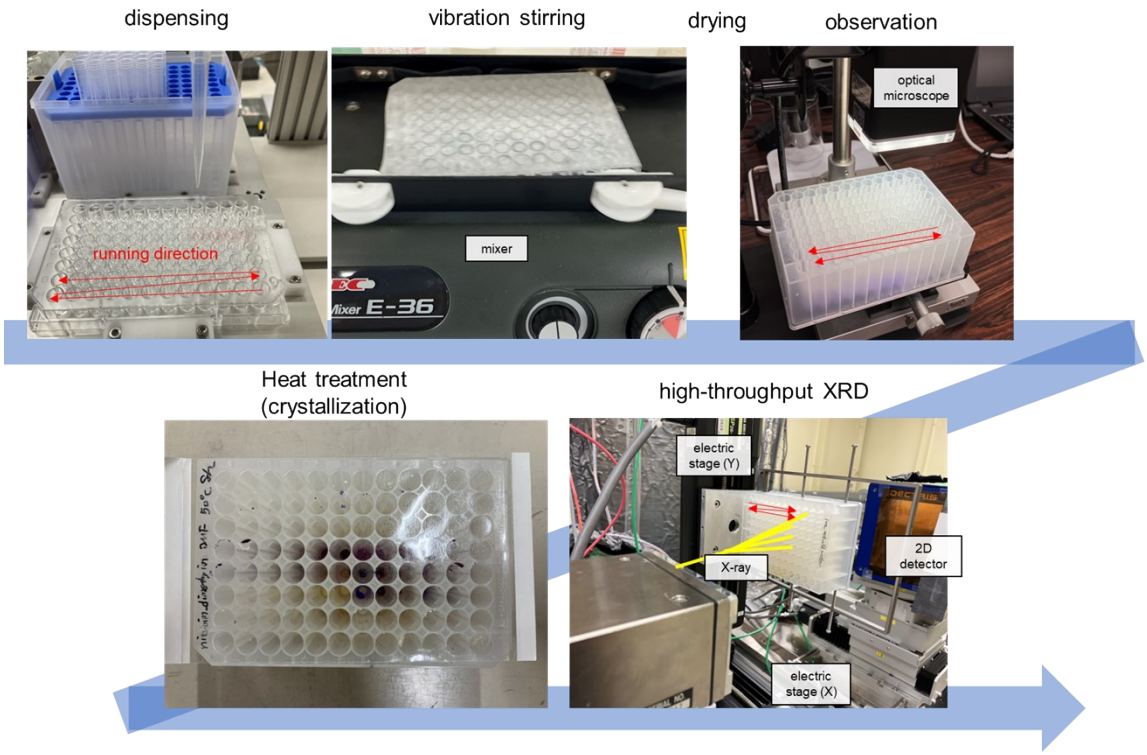

Fig. S1 Process of high-throughput screening of ZIF gels.

Table S1 Conditions for synthesis of ZIF gels in im-bim system. Unit of volume: μL.

Name	M1				L1		L2		S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05M, EtOH	Im 0.1 M, water	Im 0.1 M, EtOH	Bim 0.1 M, water	Bim 0.1 M, EtOH	water	EtOH	NaOH water, 0.2M	KOH water, 0.2M	1: wet gel 0: dry solid
Im-bim_2	90					70		10					0
Im-bim_3	90					84		12					0
Im-bim_4	90					50		7.5		40			0
Im-bim_5	90					70		10		40			0
Im-bim_6	90					84		12		40			0
Im-bim_7	90					50		7.5			20		0
Im-bim_8	90					70		10			20		0
Im-bim_9	90					84		12			20		0
Im-bim_10	90					50		7.5				20	0
Im-bim_11	90					70		10				20	1
Im-bim_12	90					84		12				20	1
Im-bim_14	90					70		10					0
Im-bim_15	90					84		12					0
Im-bim_16	90					50		7.5		40			0
Im-bim_17	90					70		10		40			0
Im-bim_18	90					84		12		40			0
Im-bim_19		90			50		7.5						0
Im-bim_20		90			70		10						0
Im-bim_21		90			84		12						0
Im-bim_22		90			50		7.5		40				0
Im-bim_23		90			70		10		40				0
Im-bim_24		90			84		12		40				0
Im-bim_26		90			70		10				20		0
Im-bim_27		90			84		12				20		0
Im-bim_28		90			50		7.5					20	0
Im-bim_29		90			70		10					20	0
Im-bim_30		90			84		12					20	0
Im-bim_31		90			50		7.5						0
Im-bim_32		90			70		10						0
Im-bim_33		90			84		12						0
Im-bim_34		90			50		7.5		40				0
Im-bim_35		90			70		10		40				0
Im-bim_36		90			84		12		40				0
Im-bim_38				90		70		10					0
Im-bim_39				90		84		12					0
Im-bim_40				90		50		7.5		40			0
Im-bim_41				90		70		10		40			0
Im-bim_42				90		84		12		40			0
Im-bim_43				90		50		7.5			20		0
Im-bim_44				90		70		10			20		0
Im-bim_45				90		84		12			20		0
Im-bim_46				90		50		7.5				20	0
Im-bim_47				90		70		10				20	0
Im-bim_48				90		84		12				20	0
Im-bim_50				90		70		10					0
Im-bim_51				90		84		12					0
Im-bim_52				90		50		7.5		40			0
Im-bim_53				90		70		10		40			0
Im-bim_54				90		84		12		40			0
Im-bim_55			90		50		7.5						0

Im-bim_56	90	70	10				0
Im-bim_57	90	84	12				0
Im-bim_58	90	50	7.5	40			0
Im-bim_59	90	70	10	40			0
Im-bim_60	90	84	12	40			0
Im-bim_62	90	70	10		20		0
Im-bim_63	90	84	12		20		0
Im-bim_64	90	50	7.5			20	0
Im-bim_65	90	70	10			20	0
Im-bim_66	90	84	12			20	0
Im-bim_67	90	50	7.5				0
Im-bim_68	90	70	10				0
Im-bim_69	90	84	12				0
Im-bim_70	90	50	7.5	40			0
Im-bim_71	90	70	10	40			0
Im-bim_72	90	84	12	40			0

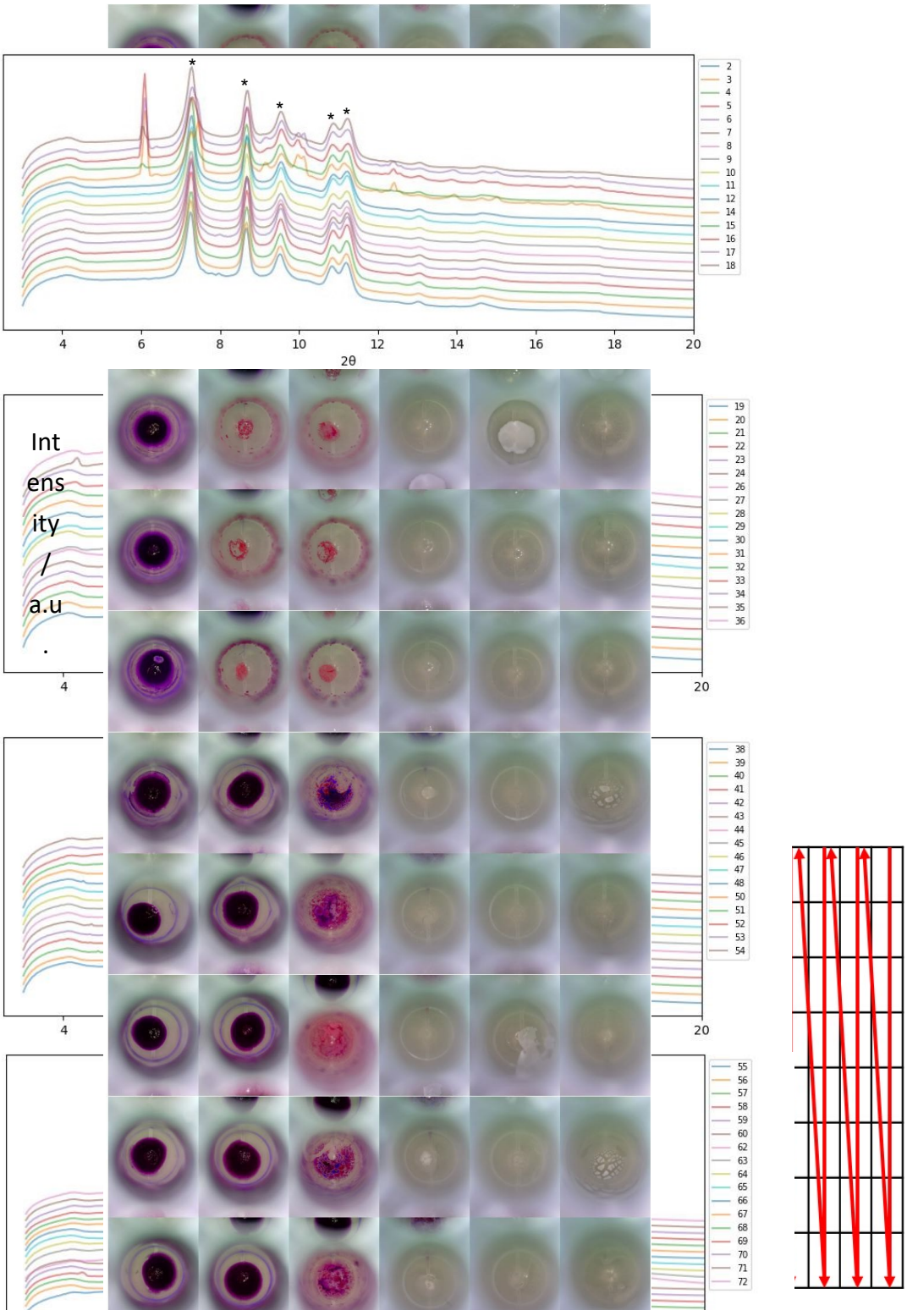

Fig. S2 Photographs of the gels synthesized in the im-bim system, arranged in the order of synthesis conditions as indicated in the inset

Fig. S3 XRD patterns of the heat-treated ZIF-gels in im-bim system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S2 Conditions for synthesis of the ZIF gels in im-mim system. Unit of volume: μL.

Name	M1				L1		L2		S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	Im 0.1 M, water	Im 0.1 M, EtOH	Mim 0.1 M, water	Mim 0.1 M, EtOH	water	EtOH	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
Im-mim_2	60					40		40					1
Im-mim_3	60					60		60					1
Im-mim_4	60					20		20		40			0
Im-mim_5	60					40		40		40			1
Im-mim_6	60					60		60		40			1
Im-mim_7	60					20		20			20		1
Im-mim_8	60					40		40			20		1
Im-mim_9	60					60		60			20		1
Im-mim_10	60					20		20				20	1
Im-mim_11	60					40		40				20	1
Im-mim_12	60					60		60				20	1
Im-mim_14	90					70		20					1
Im-mim_15	90					90		30					1
Im-mim_16	90					45		15		40			1
Im-mim_17	90					70		20		40			1
Im-mim_18	90					90		30		40			1
Im-mim_19	90					45		15			20		0
Im-mim_20	90					70		20			20		0
Im-mim_21	90					90		30			20		0
Im-mim_22	90					45		15				20	0
Im-mim_23	90					70		20				20	0
Im-mim_24	90					90		30				20	0
Im-mim_26		60			40		40						0
Im-mim_27		60			60		60						0
Im-mim_28		60			20		20		40				0
Im-mim_29		60			40		40		40				1
Im-mim_30		60			60		60		40				1
Im-mim_31		60			20		20				20		1
Im-mim_32		60			40		40				20		1
Im-mim_33		60			60		60				20		1
Im-mim_34		60			20		20					20	1
Im-mim_35		60			40		40					20	1
Im-mim_36		60			60		60					20	1
Im-mim_38		90			70		20						0
Im-mim_39		90			90		30						0
Im-mim_40		90			45		15		40				0
Im-mim_41		90			70		20		40				1
Im-mim_42		90			90		30		40				1
Im-mim_43		90			45		15				20		1
Im-mim_44		90			70		20				20		1
Im-mim_45		90			90		30				20		1
Im-mim_46		90			45		15					20	1
Im-mim_47		90			70		20					20	1
Im-mim_48		90			90		30					20	1
Im-mim_50				60		40		40					1
Im-mim_51				60		60		60					1
Im-mim_52				60		20		20		40			0
Im-mim_53				60		40		40		40			1
Im-mim_54				60		60		60		40			1
Im-mim_55				60		20		20			20		1

Im-mim_56				60		40		40			20		0
Im-mim_57				60		60		60			20		1
Im-mim_58				60		20		20				20	1
Im-mim_59				60		40		40				20	0
Im-mim_60				60		60		60				20	1
Im-mim_62				90		70		20					1
Im-mim_63				90		90		30					1
Im-mim_64				90		45		15		40			1
Im-mim_65				90		70		20		40			1
Im-mim_66				90		90		30		40			1
Im-mim_67				90		45		15			20		0
Im-mim_68				90		70		20			20		1
Im-mim_69				90		90		30			20		1
Im-mim_70				90		45		15				20	0
Im-mim_71				90		70		20				20	1
Im-mim_72				90		90		30				20	1
Im-mim_74		60		40		40							0
Im-mim_75		60		60		60							0
Im-mim_76		60		20		20		40					0
Im-mim_77		60		40		40		40					0
Im-mim_78		60		60		60		40					0
Im-mim_79		60		20		20					20		1
Im-mim_80		60		40		40					20		1
Im-mim_81		60		60		60					20		0
Im-mim_82		60		20		20						20	0
Im-mim_83		60		40		40						20	0
Im-mim_84		60		60		60						20	0
Im-mim_86		90		70		20							0
Im-mim_87		90		90		30							0
Im-mim_88		90		45		15		40					0
Im-mim_89		90		70		20		40					0
Im-mim_90		90		90		30		40					0
Im-mim_91		90		45		15					20		0
Im-mim_92		90		70		20					20		0
Im-mim_93		90		90		30					20		0
Im-mim_94		90		45		15						20	0
Im-mim_95		90		70		20						20	0
Im-mim_96		90		90		30						20	0

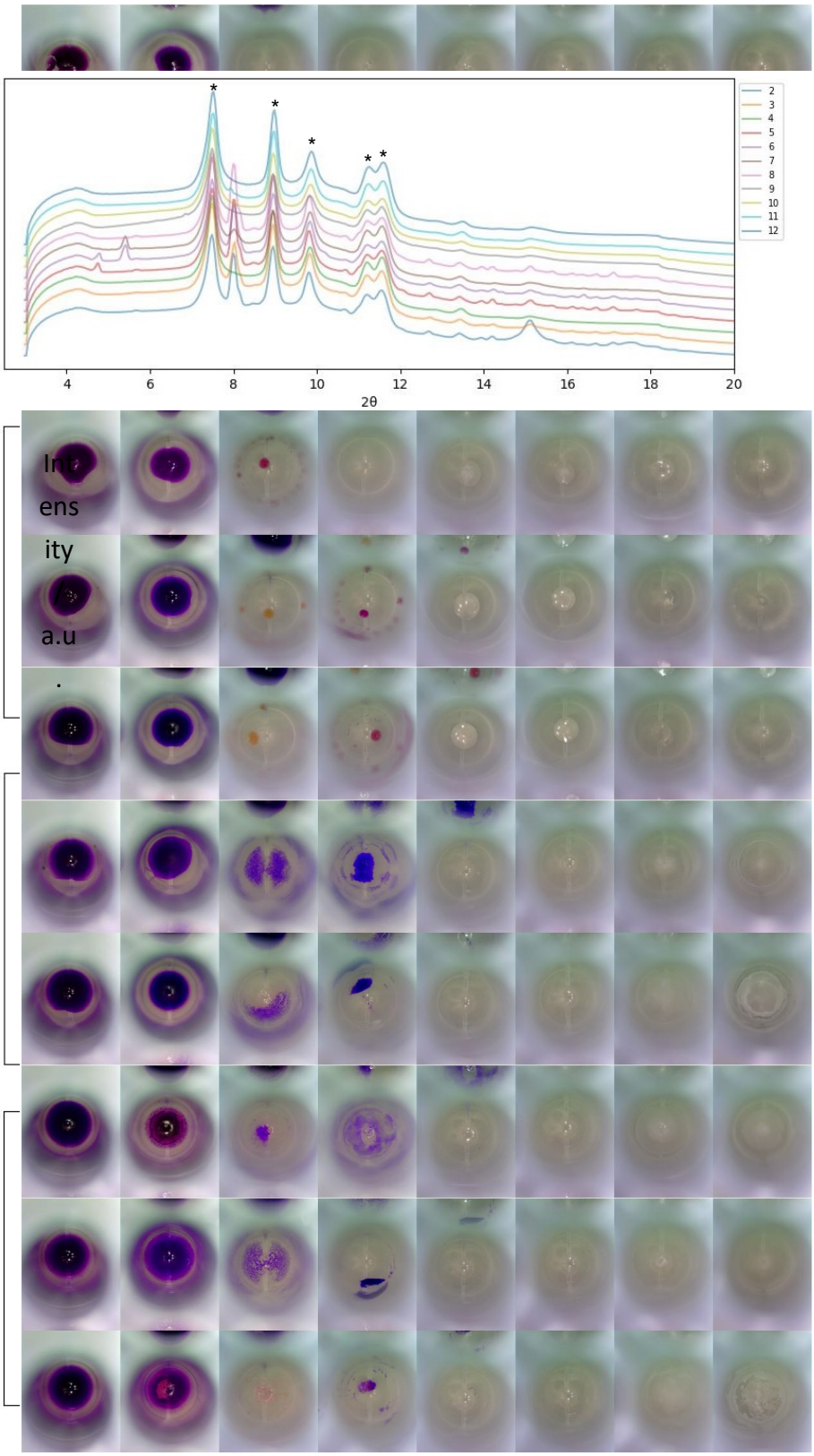

Fig. S4 Photographs of the synthesized gels in im-mim system. See Fig. S2 for the order of the photos. the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

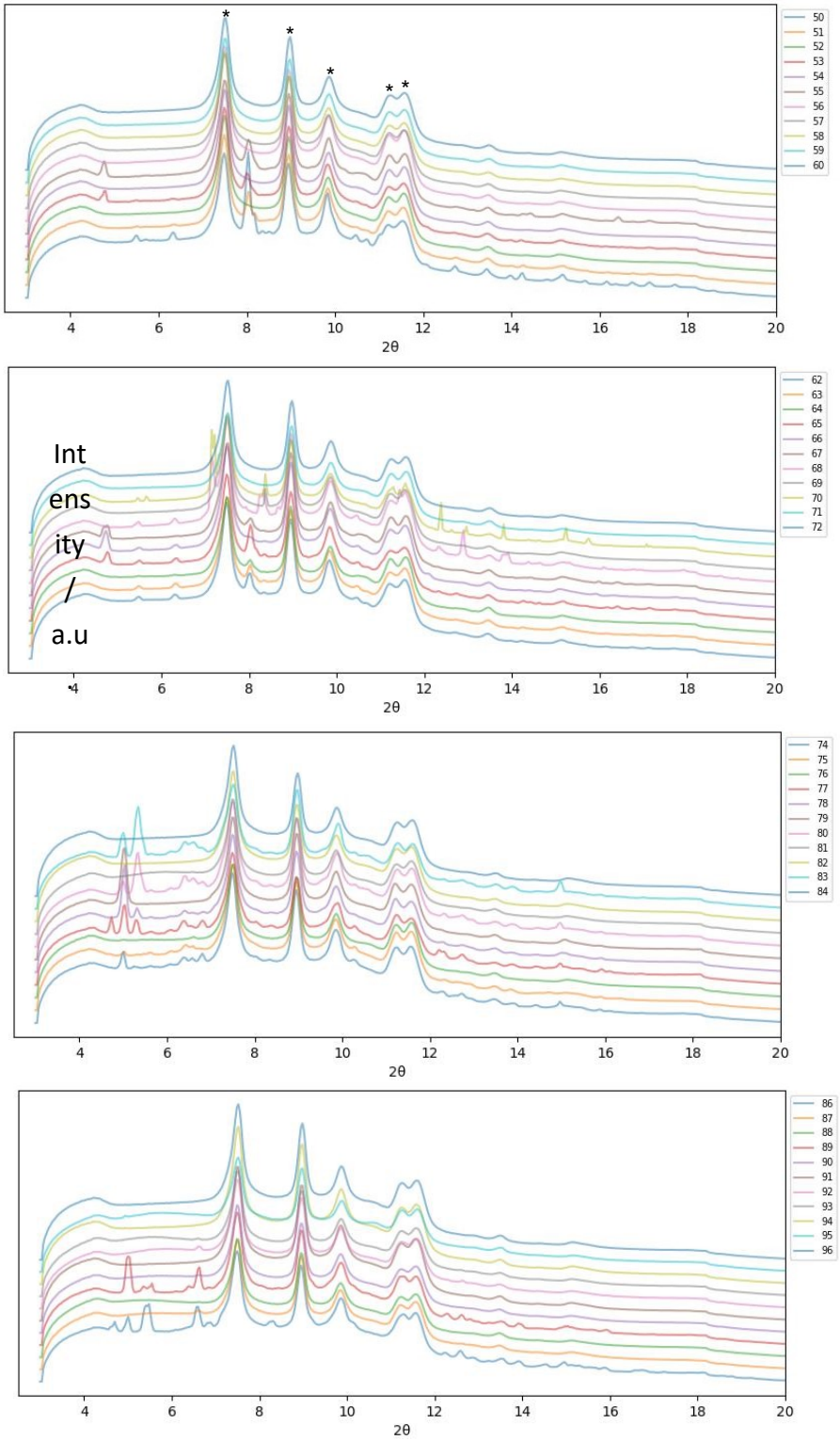

Fig. S5 XRD patterns of the heat-treated ZIF-gels in im-mim system (continued). The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S3 Conditions for synthesis of the ZIF gels in nim-dmbim system. Unit of volume: μL.

Name	M1		L1	L2	S1		B1		Gel state
	ZnAc 0.2 M, DMF	CoAc 0.2 M, DMF	nim 0.2 M, DMF	dmbim 0.2 M, DMF	water	DMF	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
nim-dmbim_2	80		160	25					0
nim-dmbim_3	80		200	30					0
nim-dmbim_4	80		140	20	40				0
nim-dmbim_5	80		160	25	40				0
nim-dmbim_6	80		200	30	40				0
nim-dmbim_7	80		140	20		40			0
nim-dmbim_8	80		160	25		40			0
nim-dmbim_9	80		200	30		40			0
nim-dmbim_10	80		140	20			40		1
nim-dmbim_11	80		160	25			40		1
nim-dmbim_12	80		200	30			40		1
nim-dmbim_14	80		160	25				40	1
nim-dmbim_15	80		200	30				40	1
nim-dmbim_16	20		20	20					0
nim-dmbim_17	20		60	60					1
nim-dmbim_18	20		80	80					1
nim-dmbim_19	20		20	20	40				0
nim-dmbim_20	20		60	60	40				1
nim-dmbim_21	20		80	80	40				1
nim-dmbim_22	20		20	20		40			0
nim-dmbim_23	20		60	60		40			1
nim-dmbim_24	20		80	80		40			1
nim-dmbim_26	20		60	60			40		1
nim-dmbim_27	20		80	80			40		1
nim-dmbim_28	20		20	20				40	0
nim-dmbim_29	20		60	60				40	1
nim-dmbim_30	20		80	80				40	1
nim-dmbim_31		20	20	20					0
nim-dmbim_32		20	60	60					1
nim-dmbim_33		20	80	80					1
nim-dmbim_34		20	20	20	40				0
nim-dmbim_35		20	60	60	40				1
nim-dmbim_36		20	80	80	40				1
nim-dmbim_38		20	60	60		40			1
nim-dmbim_39		20	80	80		40			1
nim-dmbim_40		20	20	20			40		0
nim-dmbim_41		20	60	60			40		0
nim-dmbim_42		20	80	80			40		1
nim-dmbim_43		20	20	20				40	1
nim-dmbim_44		20	60	60				40	1
nim-dmbim_45		20	80	80				40	1
nim-dmbim_46		80	140	20					0
nim-dmbim_47		80	160	25					0
nim-dmbim_48		80	200	30					0
nim-dmbim_50		80	160	25	40				0
nim-dmbim_51		80	200	30	40				1
nim-dmbim_52		80	140	20		40			1
nim-dmbim_53		80	160	25		40			1

nim-dmbim_54	80	200	30	40			1
nim-dmbim_55	80	140	20		40		0
nim-dmbim_56	80	160	25		40		0
nim-dmbim_57	80	200	30		40		0
nim-dmbim_58	80	140	20			40	0
nim-dmbim_59	80	160	25			40	1
nim-dmbim_60	80	200	30			40	1

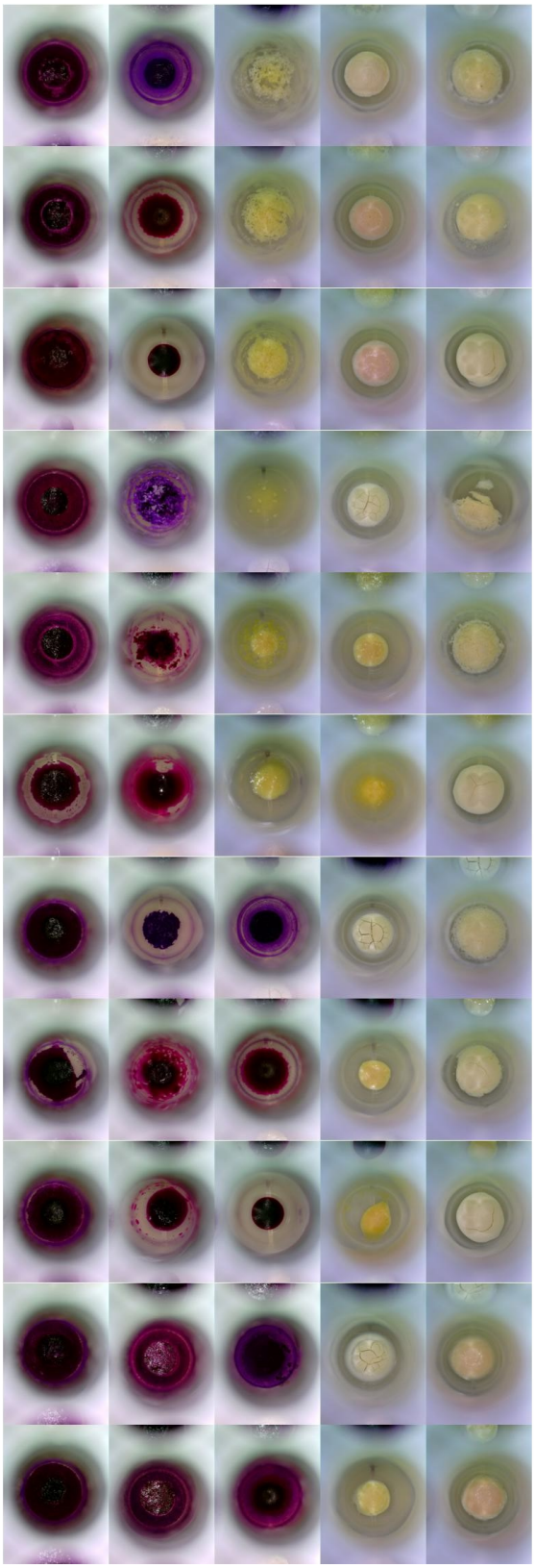

Fig. S6 Photographs of the synthesized gels in nim-dmbim system. See Fig. S2 for the order of the photos.

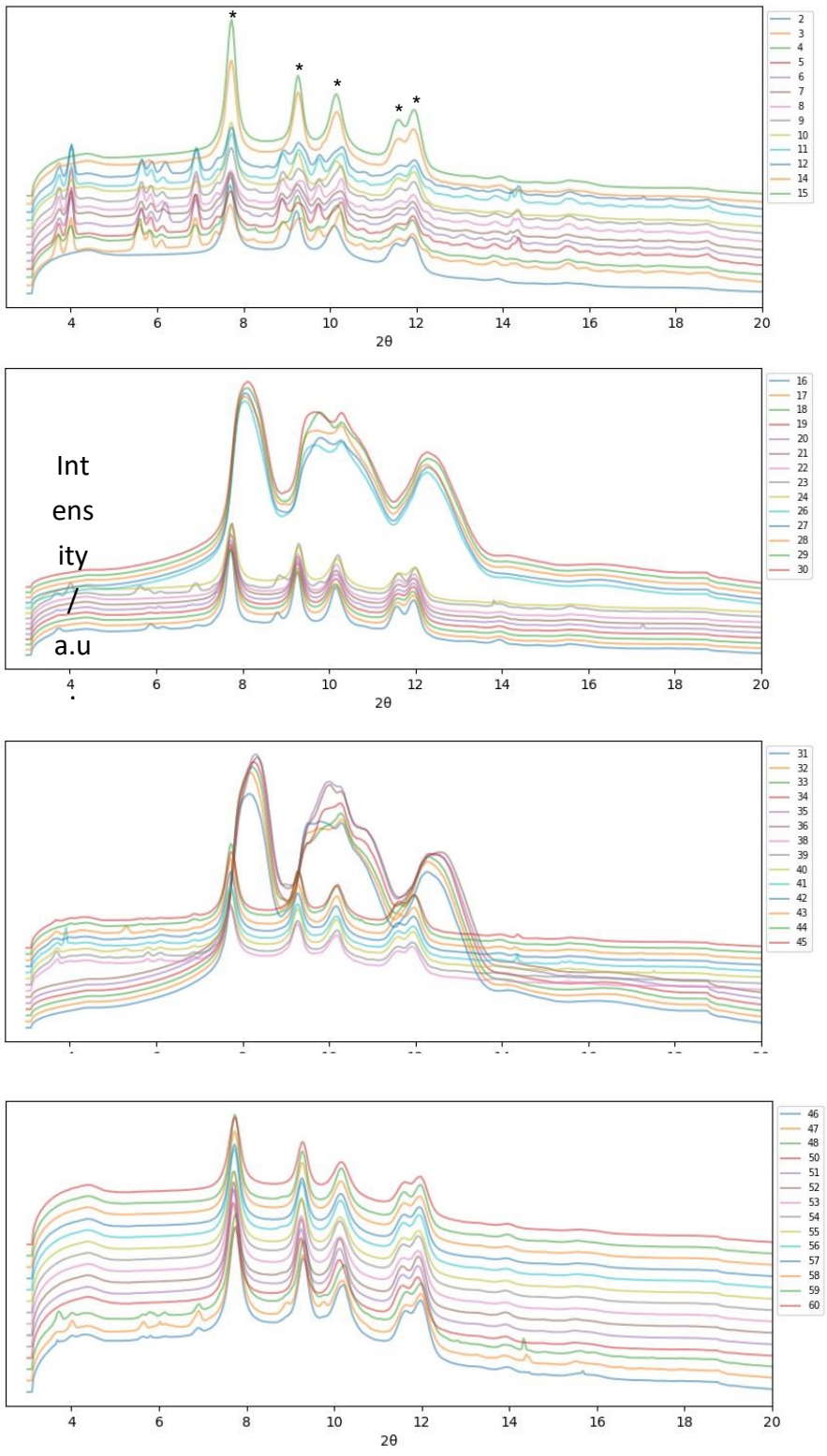

Fig. S7 XRD patterns of the heat-treated ZIF-gels in nim-dmbim system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S4 Conditions for synthesis of the ZIF gels in dcim system. Unit of volume: µL.

Name	M1				L1	S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	dcim 0.1 M, EtOH	water	EtOH	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
dcim_2	60				60					0
dcim_3	60				80					0
dcim_4	60				100					0
dcim_5	60				40			20		0
dcim_6	60				40				20	0
dcim_7	60				60			30		0
dcim_8	60				60				30	0
dcim_9	60				80			40		0
dcim_10	60				80				40	0
dcim_11	60				100			50		0
dcim_12	60				100				50	0
dcim_14	60				60		60			0
dcim_15	60				80		60			0
dcim_16	60				100		60			0
dcim_17	60				40		60	20		0
dcim_18	60				40		60		20	0
dcim_19	60				60		60	30		0
dcim_20	60				60		60		30	0
dcim_21	60				80		60	40		0
dcim_22	60				80		60		40	0
dcim_23	60				100		60	50		0
dcim_24	60				100		60		50	0
dcim_26				60	60					0
dcim_27				60	80					0
dcim_28				60	100					0
dcim_29				60	40			20		0
dcim_30				60	40				20	0
dcim_31				60	60			30		0
dcim_32				60	60				30	0
dcim_33				60	80			40		0
dcim_34				60	80				40	0
dcim_35				60	100			50		0
dcim_36				60	100				50	0
dcim_38				60	60		60			0
dcim_39				60	80		60			0
dcim_40				60	100		60			0
dcim_41				60	40		60	20		0
dcim_42				60	40		60		20	0
dcim_43				60	60		60	30		0
dcim_44				60	60		60		30	0
dcim_45				60	80		60	40		0
dcim_46				60	80		60		40	0
dcim_47				60	100		60	50		0
dcim_48				60	100		60		50	0

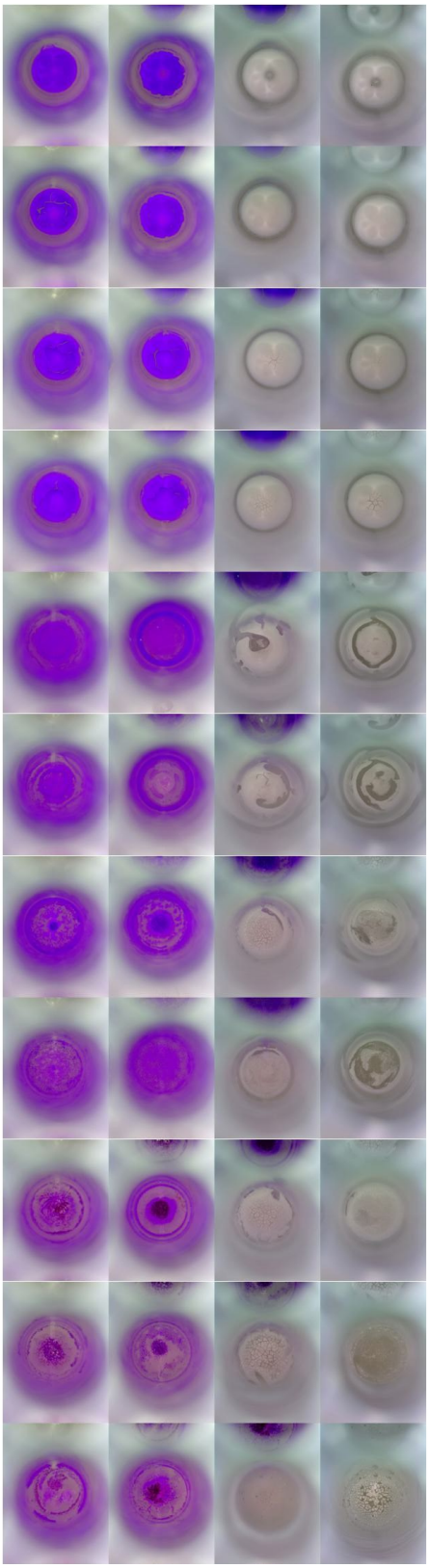

Fig. S8 Photographs of the synthesized gels in dcim system. See Fig. S2 for the order of the photos.

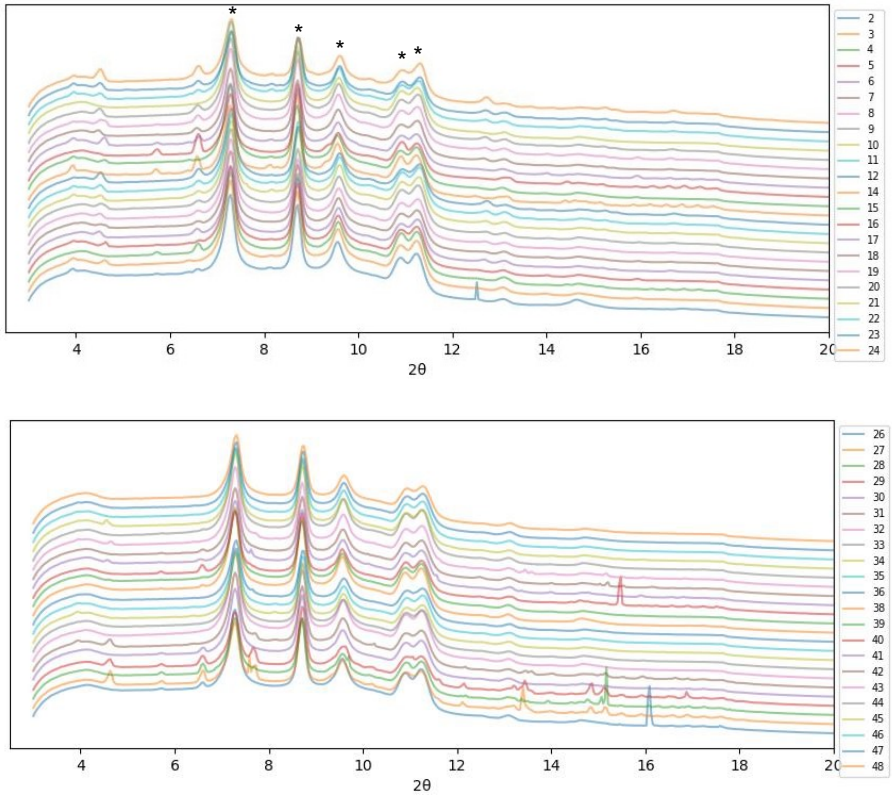

Fig. S9 XRD patterns of the heat-treated ZIF-gels in dcim system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S5 Conditions for synthesis of the ZIF gels in pr system. Unit of volume: µL.

Name	M1				L1	S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	pr 0.1 M, EtOH	water	EtOH	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
pr_2	60				60					0
pr_3	60				80					0
pr_4	60				100					0
pr_5	60				40			20		0
pr_6	60				40				20	0
pr_7	60				60			30		0
pr_8	60				60				30	0
pr_9	60				80			40		0
pr_10	60				80				40	0
pr_11	60				100			50		0
pr_12	60				100				50	0
pr_14	60				60		60			0
pr_15	60				80		60			0
pr_16	60				100		60			0
pr_17	60				40		60	20		0
pr_18	60				40		60		20	0
pr_19	60				60		60	30		0
pr_20	60				60		60		30	0
pr_21	60				80		60	40		0
pr_22	60				80		60		40	0
pr_23	60				100		60	50		0
pr_24	60				100		60		50	0
pr_26				60	60					0
pr_27				60	80					0
pr_28				60	100					0
pr_29				60	40			20		0
pr_30				60	40				20	0
pr_31				60	60			30		0
pr_32				60	60				30	1
pr_33				60	80			40		0
pr_34				60	80				40	1
pr_35				60	100			50		0
pr_36				60	100				50	1
pr_38				60	60		60			0
pr_39				60	80		60			0
pr_40				60	100		60			0
pr_41				60	40		60	20		0
pr_42				60	40		60		20	0
pr_43				60	60		60	30		0
pr_44				60	60		60		30	1
pr_45				60	80		60	40		0
pr_46				60	80		60		40	1
pr_47				60	100		60	50		0
pr_48				60	100		60		50	1

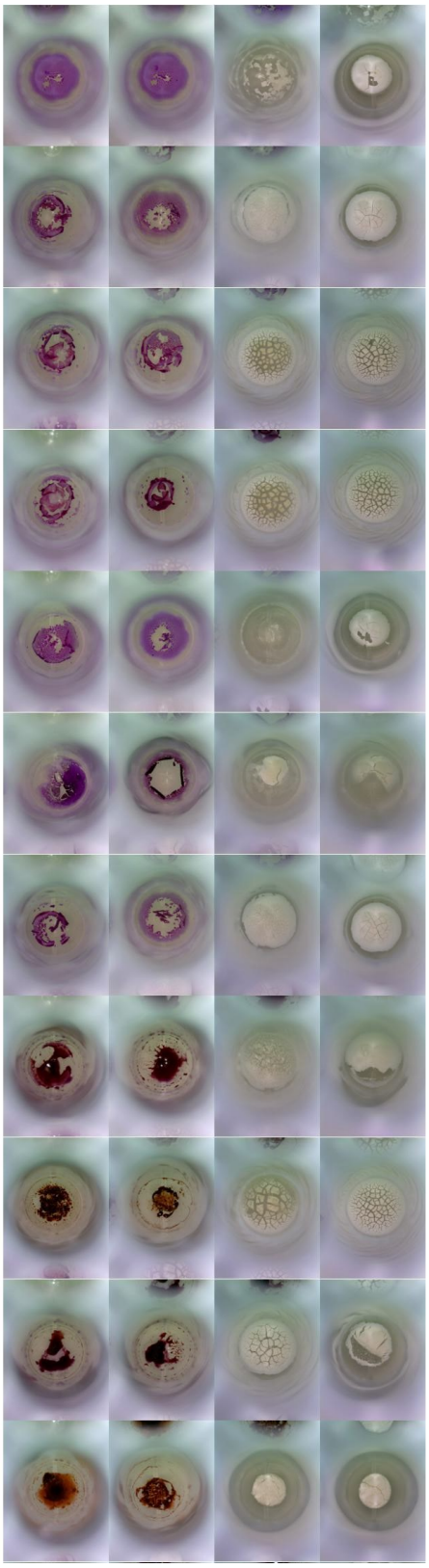

Fig. S10 Photographs of the synthesized gels in pr system. See Fig. S2 for the order of the photos.

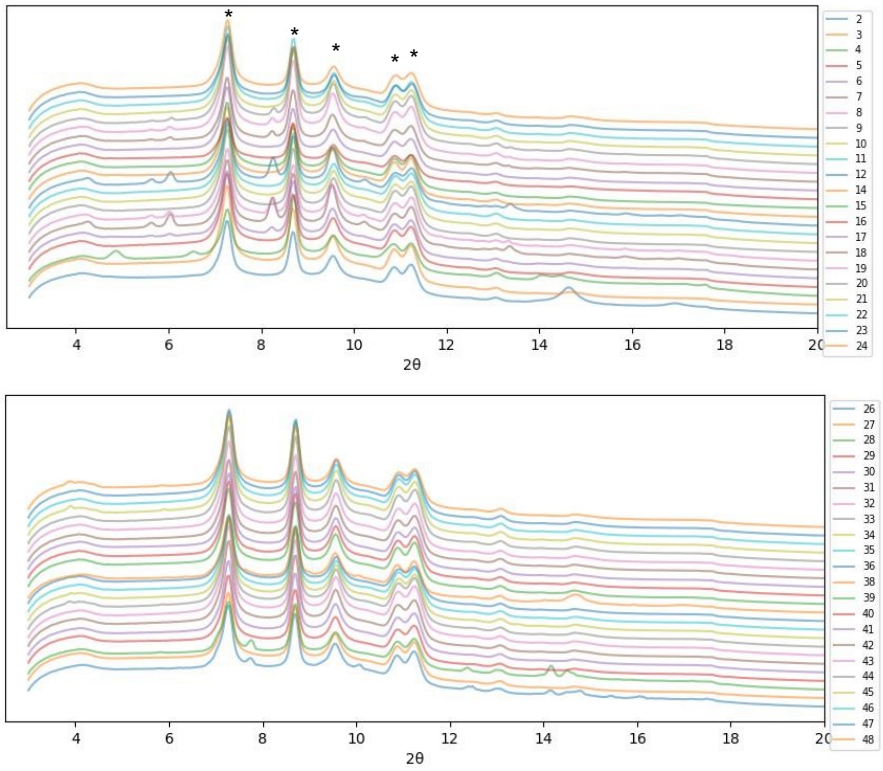

Fig. S11 XRD patterns of the heat-treated ZIF-gels in pr system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S6 Conditions for synthesis of the ZIF gels in bim system. Unit of volume: μL.

Name	M1				L1		S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	bim 0.1 M, EtOH	bim 0.1 M, water	water	EtOH	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
bim_2	60				60						0
bim_3	60				80						0
bim_4	60				100						0
bim_5	60				40				20		0
bim_6	60				40					20	0
bim_7	60				60				30		0
bim_8	60				60					30	0
bim_9	60				80				40		0
bim_10	60				80					40	0
bim_11	60				100				50		0
bim_12	60				100					50	0
bim_14	60				60			60			0
bim_15	60				80			60			0
bim_16	60				100			60			0
bim_17	60				40			60	20		0
bim_18	60				40			60		20	0
bim_19	60				60			60	30		0
bim_20	60				60			60		30	0
bim_21	60				80			60	40		0
bim_22	60				80			60		40	0
bim_23	60				100			60	50		0
bim_24	60				100			60		50	0
bim_26		60				60					0
bim_27		60				80					0
bim_28		60				100					0
bim_29		60				40			20		0
bim_30		60				40				20	0
bim_31		60				60			30		0
bim_32		60				60				30	0
bim_33		60				80			40		0
bim_34		60				80				40	1
bim_35		60				100			50		1
bim_36		60				100				50	1
bim_38		60				60	60				0
bim_39		60				80	60				0
bim_40		60				100	60				0
bim_41		60				40	60		20		0
bim_42		60				40	60			20	1
bim_43		60				60	60		30		0
bim_44		60				60	60			30	1
bim_45		60				80	60		40		0
bim_46		60				80	60			40	1
bim_47		60				100	60		50		1
bim_48		60				100	60			50	1
bim_50			60			60					0
bim_51			60			80					0
bim_52			60			100					0
bim_53			60			40			20		0

bim_54	60			40			20	0
bim_55	60			60		30		0
bim_56	60			60			30	0
bim_57	60			80		40		0
bim_58	60			80			40	0
bim_59	60			100		50		0
bim_60	60			100			50	1
bim_62	60			60	60			0
bim_63	60			80	60			0
bim_64	60			100	60			0
bim_65	60			40	60	20		0
bim_66	60			40	60		20	0
bim_67	60			60	60	30		0
bim_68	60			60	60		30	0
bim_69	60			80	60	40		0
bim_70	60			80	60		40	0
bim_71	60			100	60	50		0
bim_72	60			100	60		50	0
bim_74		60	60					0
bim_75		60	80					0
bim_76		60	100					0
bim_77		60	40			20		0
bim_78		60	40				20	0
bim_79		60	60			30		0
bim_80		60	60				30	0
bim_81		60	80			40		0
bim_82		60	80				40	0
bim_83		60	100			50		0
bim_84		60	100				50	0
bim_86		60	60		60			0
bim_87		60	80		60			0
bim_88		60	100		60			0
bim_89		60	40		60	20		0
bim_90		60	40		60		20	0
bim_91		60	60		60	30		0
bim_92		60	60		60		30	0
bim_93		60	80		60	40		0
bim_94		60	80		60		40	0
bim_95		60	100		60	50		0
bim_96		60	100		60		50	0

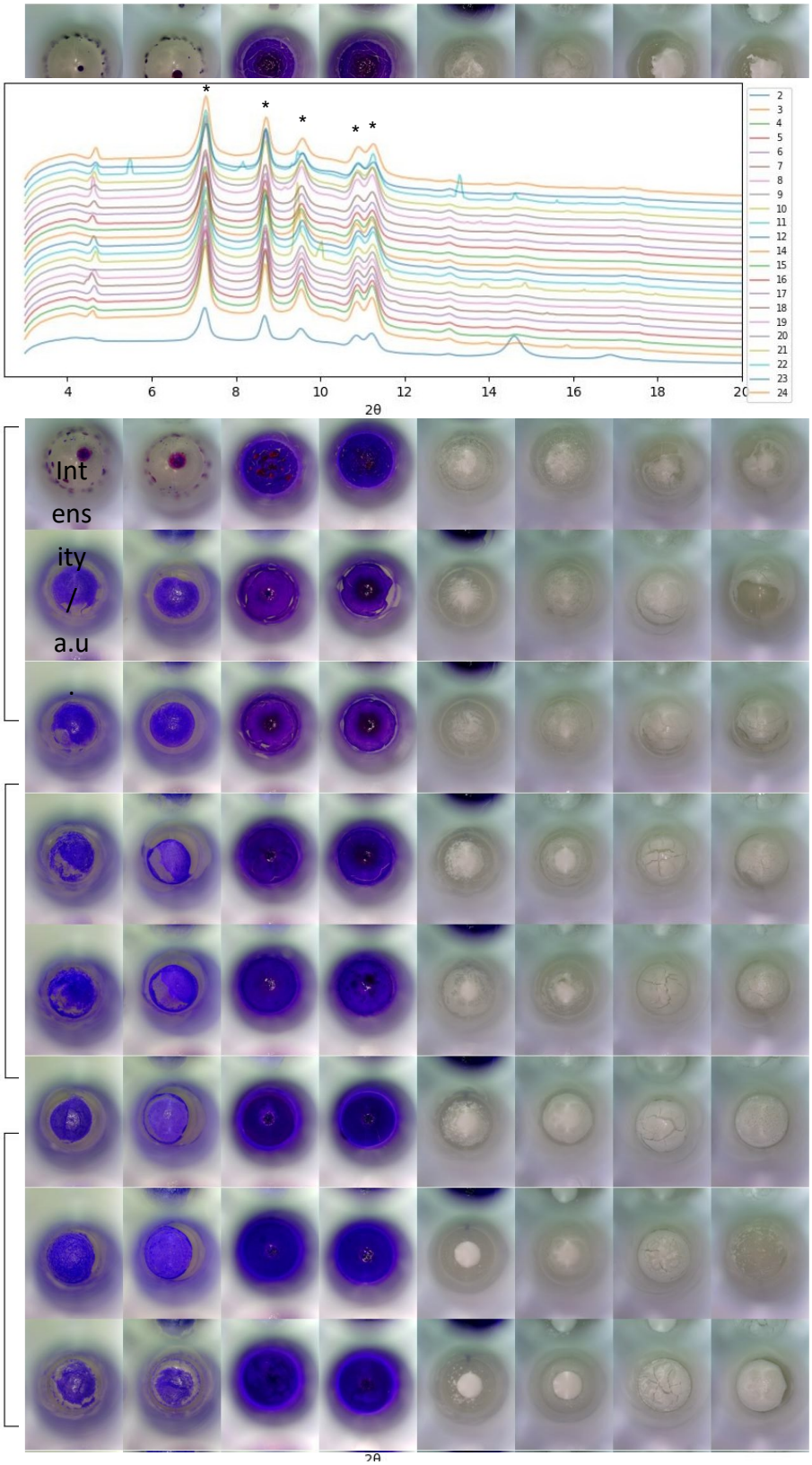

Fig. S13 XRD patterns of the heat-treated ZIF-gels in bim system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

Table S7 Conditions for synthesis of the ZIF gels in im system. Unit of volume: μL.

Name	M1				L1		S1		B1		Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	im 0.1 M, EtOH	im 0.1 M, water	water	EtOH	NaOH water, 0.2 M	KOH water, 0.2 M	1: wet gel 0: dry solid
im_2	60				60						0
im_3	60				80						1
im_4	60				100						1
im_5	60				40				20		1
im_6	60				40					20	1
im_7	60				60				30		1
im_8	60				60					30	1
im_9	60				80				40		1
im_10	60				80					40	1
im_11	60				100				50		1
im_12	60				100					50	1
im_14	60				60			60			1
im_15	60				80			60			1
im_16	60				100			60			1
im_17	60				40			60	20		1
im_18	60				40			60		20	1
im_19	60				60			60	30		1
im_20	60				60			60		30	1
im_21	60				80			60	40		1
im_22	60				80			60		40	1
im_23	60				100			60	50		1
im_24	60				100			60		50	1
im_26		60				60					1
im_27		60				80					1
im_28		60				100					1
im_29		60				40			20		1
im_30		60				40				20	1
im_31		60				60			30		1
im_32		60				60				30	1
im_33		60				80			40		1
im_34		60				80				40	1
im_35		60				100			50		0
im_36		60				100				50	1
im_38		60				60	60				1
im_39		60				80	60				1
im_40		60				100	60				1
im_41		60				40	60		20		1
im_42		60				40	60			20	1
im_43		60				60	60		30		1
im_44		60				60	60			30	1
im_45		60				80	60		40		1
im_46		60				80	60			40	1
im_47		60				100	60		50		1
im_48		60				100	60			50	1
im_50			60			60					0
im_51			60			80					0
im_52			60			100					0
im_53			60			40			20		0

im_54	60			40			20	0
im_55	60			60		30		0
im_56	60			60			30	1
im_57	60			80		40		0
im_58	60			80			40	0
im_59	60			100		50		0
im_60	60			100			50	0
im_62	60			60	60			0
im_63	60			80	60			0
im_64	60			100	60			0
im_65	60			40	60	20		0
im_66	60			40	60		20	0
im_67	60			60	60	30		0
im_68	60			60	60		30	1
im_69	60			80	60	40		0
im_70	60			80	60		40	1
im_71	60			100	60	50		1
im_72	60			100	60		50	0
im_74		60	60					1
im_75		60	80					1
im_76		60	100					1
im_77		60	40			20		0
im_78		60	40				20	0
im_79		60	60			30		1
im_80		60	60				30	1
im_81		60	80			40		1
im_82		60	80				40	1
im_83		60	100			50		1
im_84		60	100				50	1
im_86		60	60		60			1
im_87		60	80		60			1
im_88		60	100		60			1
im_89		60	40		60	20		1
im_90		60	40		60		20	1
im_91		60	60		60	30		1
im_92		60	60		60		30	1
im_93		60	80		60	40		1
im_94		60	80		60		40	1
im_95		60	100		60	50		1
im_96		60	100		60		50	1

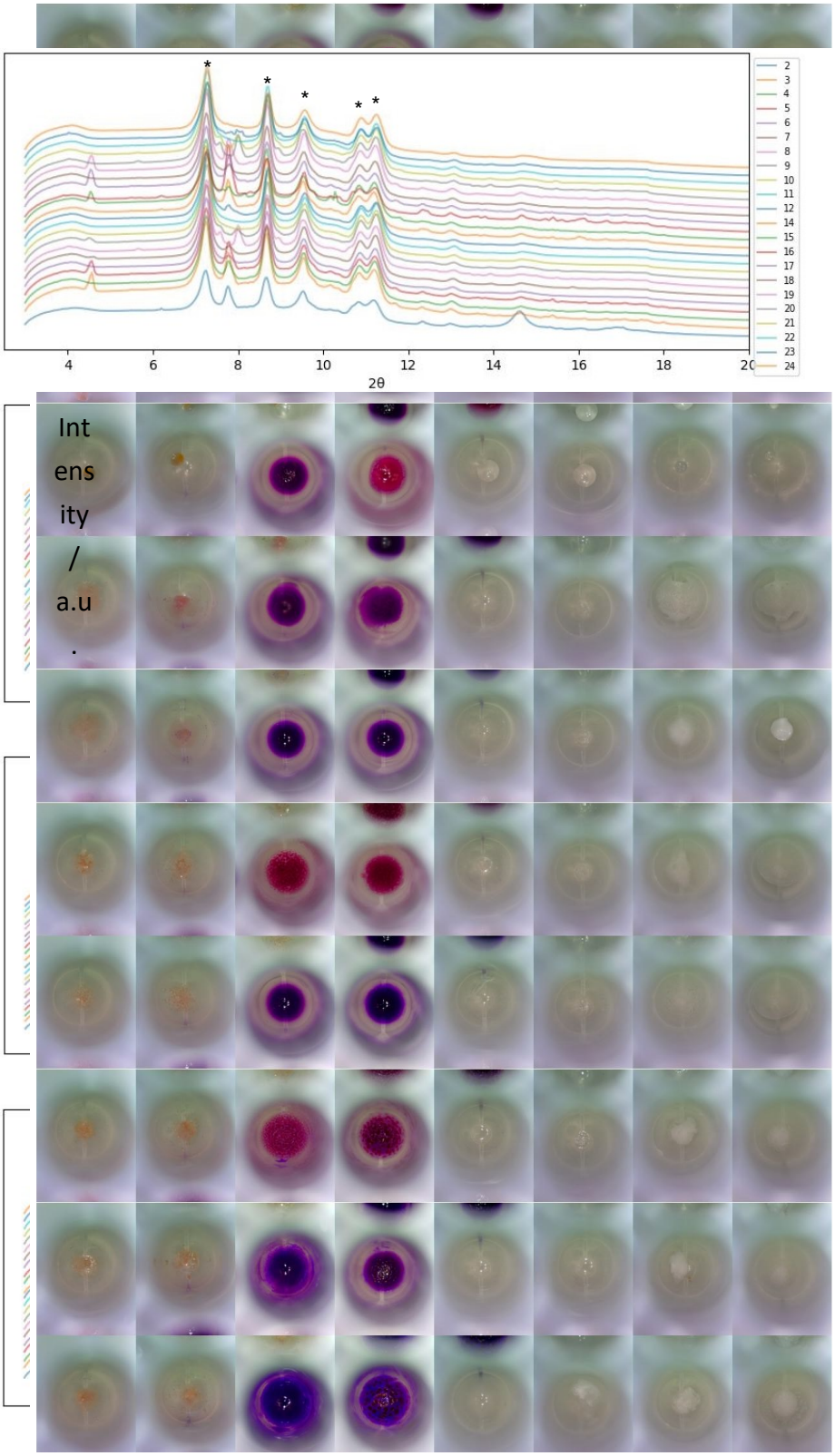

Fig. S15 XRD patterns of the heat-treated ZIF-gels in im system. The number in the legend corresponds to the number of the name in the table of synthetic conditions. * shows the peaks derived from PP.

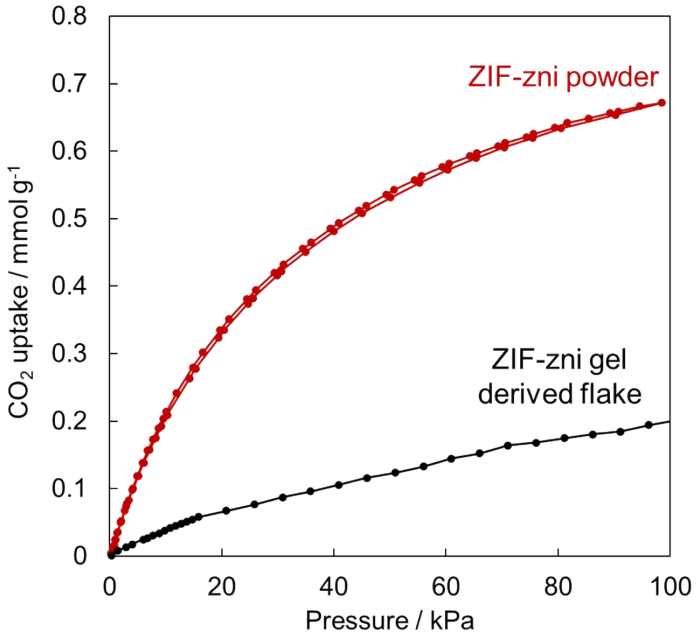

Fig. S16 CO_2 adsorption isotherms of the ZIF-zni film.

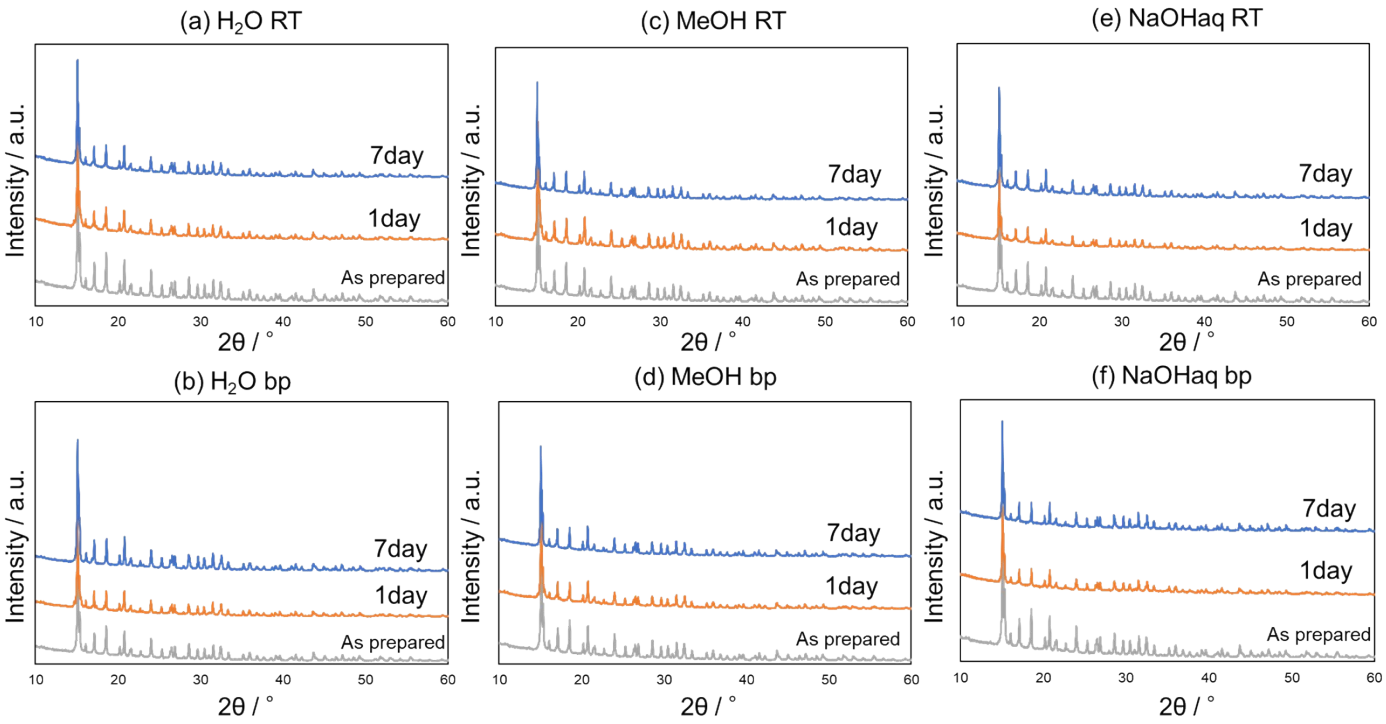

Fig. S17 Results of the ZIF-zni stability tests.

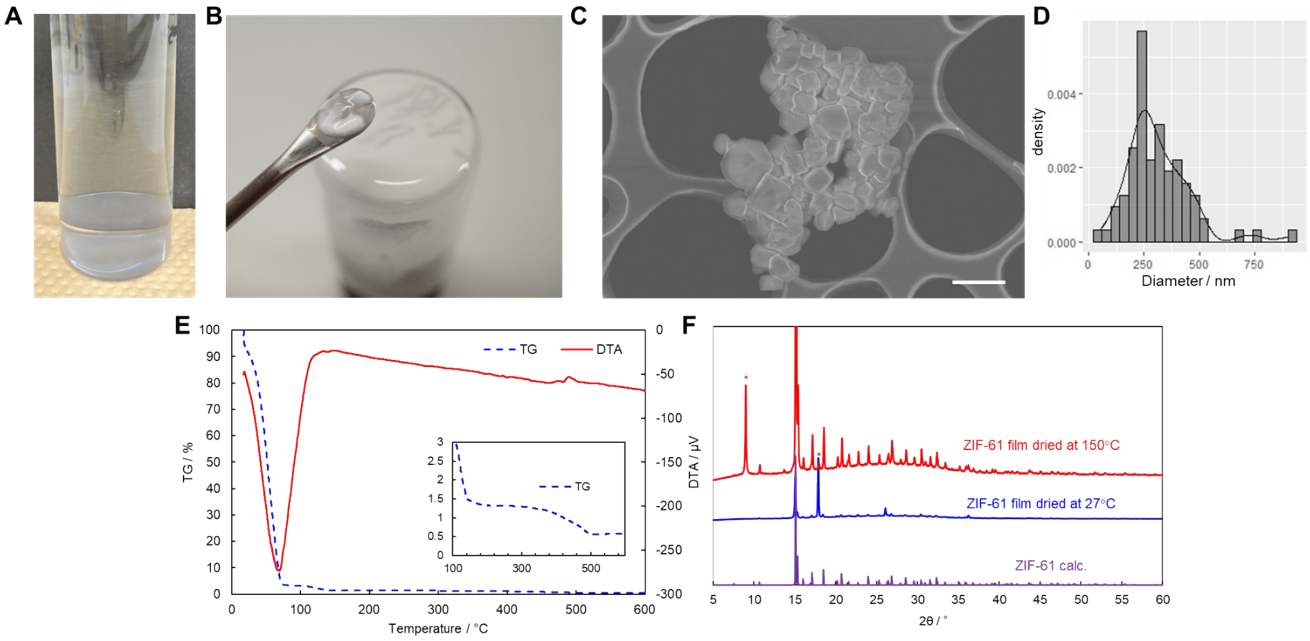

Fig. S18 Characterization of the ZIF-61 gel. A) ZIF-61colloidal solution. B) ZIF-61 gel. C) SEM images of ZIF-61 particles (scale bar: 1 µm). D) Particle size distribution of the ZIF-61. E) Thermogravimetric analysis of the ZIF-61 gel. Magnification of the high temperature range is exhibited in the inset. F) XRD patterns of the ZIF-61films. * shows the unknown peak.

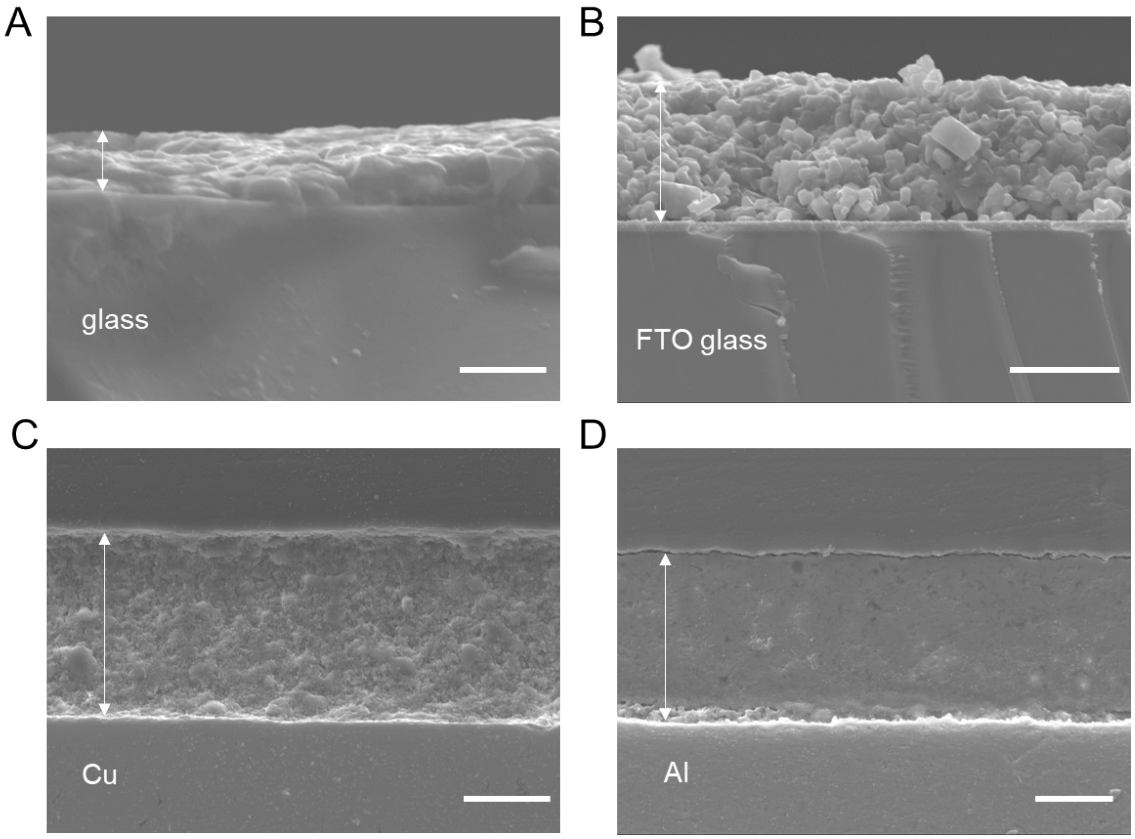

Fig. S19 Cross-sectional SEM images of ZIF-61 films on different substrates A) glass (scale bar: 2 µm). B) FTO glass (scale bar: 2 µm). C) Cu (scale bar: 10 µm). D) Al (scale bar: 10 µm).

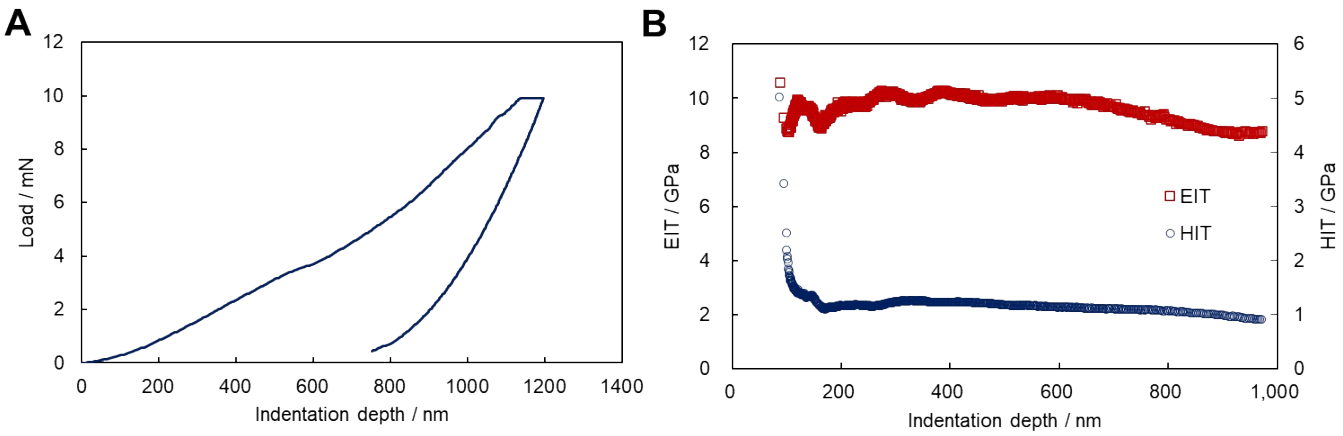

Fig. S20 Nanoindentation data of ZIF-61 films. A) Representative load-displacement curve. B) Indentation elastic moduli (EIT) and hardness (HIT) as a function of indentation depth.

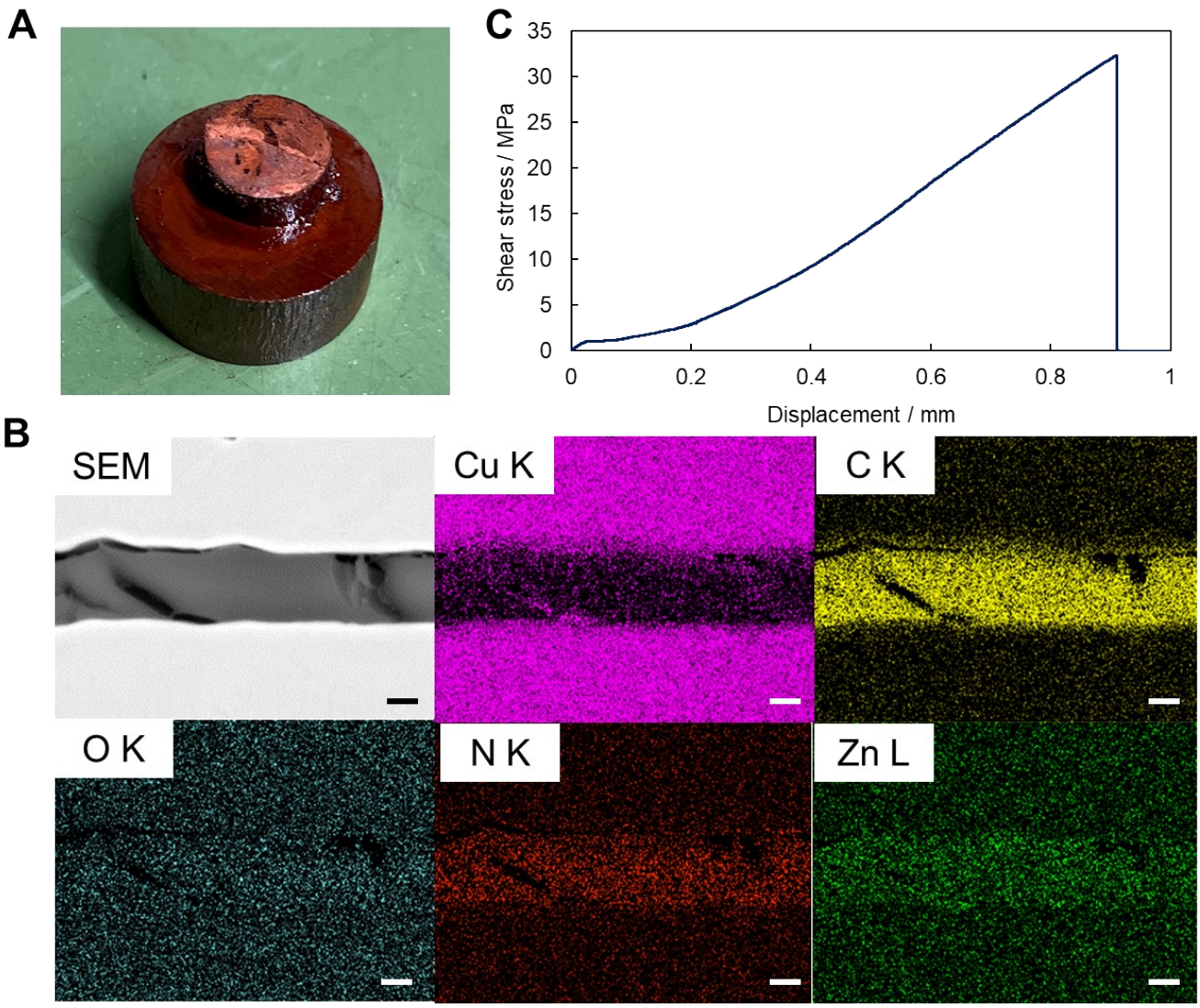

Fig. S21 Adhesive characterization of the ZIF-61 gel. A) Photograph of the adhesive body. B) Cross-sectional SEM image and EDX analysis of the adhesive body. Scale bar: 1 µm. C) Stress-displacement curve of the adhesive body.