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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.

	SI Conditi	ons for sy	nthesis o	of ZIF geis	in im-bin	n system.	Unit of V	oiume: µ	L.				
Name		Ν	11		L	1	L	2	S	1	В	1	Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05M, EtOH	lm 0.1 M, water	lm 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
lm-bim_7	90					50		7.5			20		0
lm-bim_8	90					70		10			20		0
Im-bim_9	90					84		12			20		0
lm-bim_10	90					50		7.5				20	0
lm-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
lm-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		/0		10			20		0
Im-bim_45				90		84		12			20		0
Im-bim_46				90		50		/.5				20	U
im-pim_4/				90		/0		10				20	U
im-bim_48				90		84		12				20	U
Im-bim_50				90		/0		10					U
im-bim_51				90		84		12					U
im-pim_52				90		50		1.5		40			U
im-bim_53				90		70		10		40			0
Im-bim 55			90	90	50	04	7.5	12		40			0

lm-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
lm-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.

Name		Ν	11		L	.1	L	2	S	1	В	1	Gel state
	ZnAc 0.03 M, EtOH	ZnAc 0.2 M, water	CoAc 0.2 M, water	CoAc 0.05 M, EtOH	lm 0.1 M, water	lm 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
lm-mim_2	60					40		40					1
lm-mim_3	60					60		60					1
lm-mim_4	60					20		20		40			0
lm-mim_5	60					40		40		40			1
lm-mim_6	60					60		60		40			1
Im-mim_7	60					20		20			20		1
lm-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	20	0
Im-mim 23	90					70		20				20	0
Im-mim 24	90					90		30				20	0
Im-mim 24	50	60			40	50	40	50				20	0
Im-mim_20		60			40 60		40 60						0
Im-mim 28		60			20		20		40				0
Im-mim 29		60			40		40		40				1
Im-mim_29		60			40 60		40 60		40				1
Im-mim_31		60			20		20		40		20		1
Im mim_31		60			40		40				20		1
Im mim_32		60			-0 60		-0 60				20		1
Im-mim 34		60			20		20				20	20	1
Im-mim 35		60			20		20					20	1
Im-mim_35		60			40 60		40 60					20	1
Im mim 29		00			70		20					20	1
IIII-IIIII1_38		90			20		20						0
Im-mim_39		90			90 45		15		40				0
Im-mim_40		90			70		20		40				1
Im-mim_41		90			90		30		40				1
Im-mim_42		90			30 45		15		40		20		1
Im-mim 1/		90			70		20				20		1
Im-mim 45		90			90		30				20		- 1
Im-mim 46		90			45		15				20	20	<u>-</u> 1
Im-mim 47		90			70		20					20	1
Im-mim 48		90			90		30					20	1
Im-mim 50				60		40		40					-
Im-mim 51				60		60		60					-
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

lm-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
lm-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
lm-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
lm-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 ge	ls in nim-dmbi	im system. Uni	it of volu	me: μL.			
Name	M1	L1	L2	S	1	E	81	Gel state
	ZnAc CoAc 0.2 M, DMF 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_23	20	80	80		40			- 1
nim-dmhim_26	20	60	60			40		-
nim-dmbim_27	20	80	80			40		-
nim-dmbim 28	20	20	20				40	0
nim-dmbim 29	20	60	60				40	1
nim-dmbim_20	20	80	80				40	- 1
nim-dmbim 31	20	20	20					-
nim-dmbim_32	20	60	60					1
nim-dmbim_33	20	80	80					-
nim-dmhim_34	20	20	20	40				-
nim-dmbim_35	20	60	60	40				1
nim-dmbim_36	20	80	80	40				- 1
nim-dmbim_38	20	60	60	40	40			1
nim-dmbim_39	20	80	80		40			1
nim-dmbim_39	20	20	20		40	40		0
nim-dmbim_40	20	60	60			40		0
nim dmbim_41	20	80	80			40		1
nim-dmbim_42	20	20	20			40	40	1
nim-dmbim_43	20	20 60	20 60				40	1
nim-dmbim_44	20	80	80				-0 //0	⊥ 1
nim-dmhim 45	20	00 1 <i>1</i> 0	00 2∩				40	L L
nim-dmhim_40	00	140	20					0
nim-univini_47	00	200	20					0
nim-unipim_48	۵U ۵0	200 160	5U 2E	40				0
nim-unipim_50	٥ <u>ں</u>	200	20	40				1
nim-unipim_51	٥ <u>ں</u>	200	5U 20	40	40			1
nim-dmhim 52	00 00	140	20		40 10			⊥ 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.

	finaltions for syn			ii uciiii systei		olume.	μι.			
Name		M	1		L1	S	1	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

Table S4 Conditions for synthesis of the ZIF gels in dcim system. Unit of volume:  $\mu$ L.



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 C	Conditions f	or synthesis	of the ZIF	gels in pr sys	tem. Unit o	f volume:	μL.			
Name		N	/11		L1	S	L	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 Co	onditions fo	r synthesis	of the ZIF	gels in bim	system. U	nit of volu	ıme: μL.				
Name		М	1		L	.1	S	1	В	1	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
	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
		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 f	or synthesi	s of the ZII	gels in im s	system. Un	it of volur	ne: μL.				
Name		М	1		L	.1	S	1	В	1	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
	60				60			60			1
 im 15	60				80			60			1
	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
 im20	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
 im33		60				80			40		1
 im34		60				80				40	1
 im35		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_546040200im_556060300im_576080400im_586080400im_6060100500im_6260606000im_63604060200im_64604060200im_65604060200im_66604060200im_67606060301im_70608060401im_716010060501im_75608060301im_766060301im_776040200im_786060301im_816060301im_8460100501im_8460100501im_846010060201im_846010060201im_90606060301im_91606060301im_92606060301im_956010060501im_956010060501im_956010060501 <th></th>										
im_556060301im_566060301im_576080400im_5860100500im_6060100500im_6260606000im_636010060200im_66604060200im_66604060301im_66608060301im_70608060400im_716010060501im_7260100501im_756080200im_746060301im_7560100501im_7660100301im_7760401im_786060301im_8460100501im_8460100501im_846010060201im_846010060201im_90606060601im_9160606060301im_9260606060301im_9360606060301im_9460606060301 </td <td>im_54</td> <td>60</td> <td></td> <td></td> <td>40</td> <td></td> <td></td> <td></td> <td>20</td> <td>0</td>	im_54	60			40				20	0
im_56606080400im_576080400im_5960100500im_6060100500im_636080600im_646010060200im_65604060200im_66604060200im_67606060300im_68608060401im_70608060401im_716010060501im_726010060501im_746060301im_756080401im_786060301im_816080601im_8460100501im_846010060201im_846010060201im_846010060201im_90606060601im_91606060301im_9260606060301im_9460806060401im_95601006060501im_95601006060601 </td <td>im_55</td> <td>60</td> <td></td> <td></td> <td>60</td> <td></td> <td></td> <td>30</td> <td></td> <td>0</td>	im_55	60			60			30		0
im_576080400im_586080400im_5960100500im_6260606000im_63601006000im_64601006000im_65604060200im_66604060300im_67606060300im_68606060301im_70608060401im_716010060501im_726010060501im_766080200im_776040200im_786060301im_816060301im_826080401im_8460100501im_8460100501im_846060201im_90606060301im_91606060301im_94608060401im_95601006060401	im_56	60			60				30	1
im_586080400im_5960100500im_6260606000im_6360806000im_646010060200im_65604060200im_66606060300im_67606060400im_69608060401im_70608060401im_716010060501im_756080200im_766060301im_786060301im_806060301im_816080401im_826080401im_8460100501im_876060601im_876080601im_916060601im_93608060401im_94608060401im_94608060401im_956010060501im_94608060401im_94608060601im_94608060401im	im_57	60			80			40		0
im 5960100500im 6060100500im 636080600im 646010060200im 65604060200im 66606060301im 67606060301im 68606060400im 70608060401im 716010060501im 726060301im 746060501im 756080501im 7660100200im 786060301im 8360100301im 8460100501im 85608011im 8460100501im 846010060201im 846010060201im 85608060201im 91606060201im 93608060401im 93608060401im 94608060401im 956010060501	im_58	60			80				40	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   80   60   40   10     im_70   60   80   60   40   1     im_71   60   100   60   1   1     im_72   60   100   60   1   1     im_75   60   80   20   0   1     im_78   60   40   20   0   1     im_81   60   80   60   1   1     im_82   60   80   60   1   1	im_59	60			100			50		0
im_62   60   60   60   60   0     im_63   60   80   60   0     im_64   60   100   60   20   0     im_65   60   40   60   20   0     im_66   60   40   60   20   0     im_68   60   60   60   30   1     im_69   60   60   60   40   0     im_69   60   80   60   40   1     im_70   60   80   60   40   1     im_71   60   100   60   50   1     im_72   60   100   20   0   1     im_75   60   80   20   0   1     im_76   60   60   30   1   1     im_81   60   80   40   1   1     im_82   60   100   50 <td>im_60</td> <td>60</td> <td></td> <td></td> <td>100</td> <td></td> <td></td> <td></td> <td>50</td> <td>0</td>	im_60	60			100				50	0
im_636080600im_6460100600im_65604060200im_67606060300im_68606060400im_706080604010im_716010060501im_726010060501im_746060200im_7560806010im_766060101im_776040200im_786060301im_786060301im_816080401im_8460100501im_8460100501im_84606060201im_846010060201im_846010060201im_85604060301im_846010060301im_91606060301im_93608060401im_94608060401im_9560606060301im_9560606060601	im_62	60			60	60				0
im_6460100600im_65604060200im_66604060200im_676060301im_6860608060400im_70608060401im_716010060501im_726010060501im_7460608011im_75608011im_766040200im_786040200im_816080301im_8460100501im_8460100501im_8460100501im_89604060201im_89606060301im_90606060301im_91606060301im_92606060301im_93608060401im_94608060401im_95606060501im_94608060401im_95606060501im_95606060501im_956060 <t< td=""><td>im_63</td><td>60</td><td></td><td></td><td>80</td><td>60</td><td></td><td></td><td></td><td>0</td></t<>	im_63	60			80	60				0
im_65604060200im_66604060200im_67606060301im_69608060400im_70608060401im_716010060501im_726010060501im_7460608011im_756080200im_766010011im_786040200im_816060301im_8460100501im_8460100501im_8460100501im_8460100501im_85604060201im_846010060201im_91606060301im_92606060301im_93608060301im_94608060401im_956010060501im_9560606060301im_94608060401im_956010060501	im_64	60			100	60				0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_65	60			40	60		20		0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_66	60			40	60			20	0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_67	60			60	60		30		0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_68	60			60	60			30	1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_69	60			80	60		40		0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_70	60			80	60			40	1
im726010060500im7460601im7560801im76601001im776040200im786040200im796060301im806060301im806060301im816080401im8260100501im8460100501im8460100601im8460100601im8460100601im846010060201im89604060201im91606060301im92606060301im93608060401im94608060401im956010060501im966010060501	im_71	60			100	60		50		1
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 60 100 50 1   im_84 60 100 60 1   im_84 60 100 60 1   im_85 60 40 1 1   im_90 60 40 60 20 1   im_91 60 60 60 30 1   im_91 60 60 60 30 1   im_93	im_72	60			100	60			50	0
im7560801im76601001im776040200im786040200im796060301im806060301im816080401im826080401im8360100501im8460100501im8460100601im8460100601im8460100601im8460100601im846010060201im846010060201im89604060201im91606060301im92606060301im93608060401im94608060401im956010060501	im_74		60	60						1
im76601001im776040200im786040200im796060301im806060301im816080401im826080401im8360100501im8460100501im8460100601im8860100601im886010060201im90604060201im91606060301im92606060401im93608060401im94608060401im956010060501	im_75		60	80						1
im776040200im786040200im796060301im806060301im816080401im826080401im8360100501im8460100501im8460100501im866060601im8860100601im89604060201im90606060301im91606060301im92606060401im93608060401im94608060401im956010060501	im_76		60	100						1
im_786040200im_796060301im_806060301im_816080401im_826080401im_8360100501im_8460100501im_856060601im_876080601im_8860100601im_90604060201im_91606060301im_92606060301im_93608060401im_94608060401im_956010060501	im_77		60	40				20		0
im_796060301im_806060301im_816080401im_826080401im_8360100501im_8460100501im_866060601im_876080601im_8860100601im_99604060201im_91606060301im_92606060301im_93608060401im_94608060401im_956010060501	im_78		60	40					20	0
im_806060301im_816080401im_826080401im_8360100501im_8460100501im_866060601im_876080601im_8860100601im_90604060201im_91606060301im_92606060301im_93608060401im_94608060401im_956010060501	im_79		60	60				30		1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_80		60	60					30	1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_81		60	80				40		1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_82		60	80					40	1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_83		60	100				50		1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_84		60	100					50	1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_86		60	60			60			1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_87		60	80			60			1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	im_88		60	100			60			1
im_90604060201im_91606060301im_92606060301im_93608060401im_94608060401im_956010060501im_966010060501	im_89		60	40			60	20		1
im_91606060301im_92606060301im_93608060401im_94608060401im_956010060501im_966010060501	im_90		60	40			60		20	1
im_92606060301im_93608060401im_94608060401im_956010060501im_966010060501	im_91		60	60			60	30		1
im_93608060401im_94608060401im_956010060501im_966010060501	im_92		60	60			60		30	1
im_94608060401im_956010060501im_966010060501	im_93		60	80			60	40		1
im_956010060501im_966010060501	im_94		60	80			60		40	1
im_96 60 100 60 50 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<sub>2</sub> 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:  $1 \mu m$ . C) Stress-displacement curve of the adhesive body.