Electronic Supplementary Information

The production of polymer reference materials for microanalysis with high homogeneity by 3D printing method

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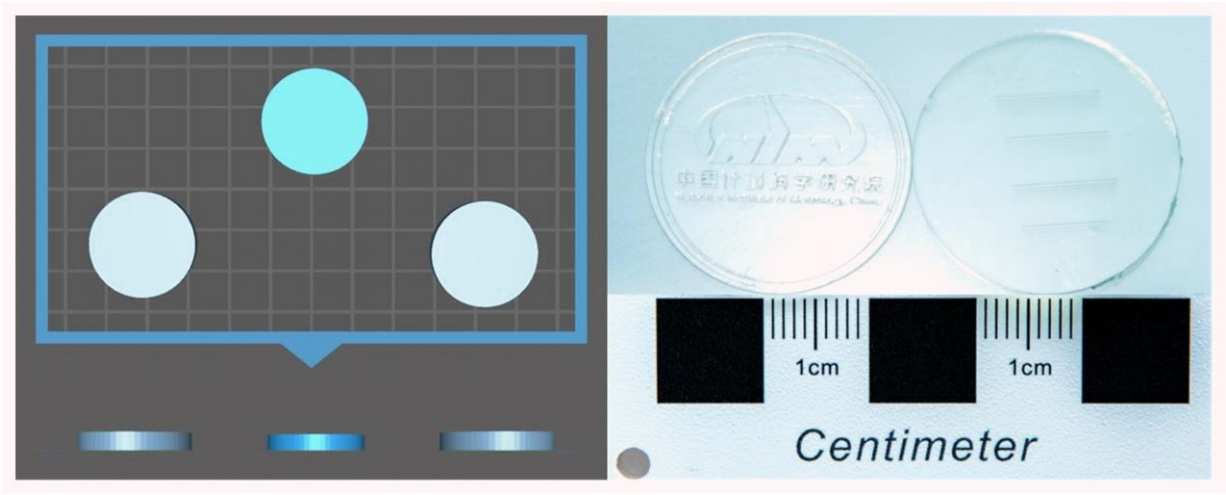

Figure S1. 3D model and picture of printed samples.

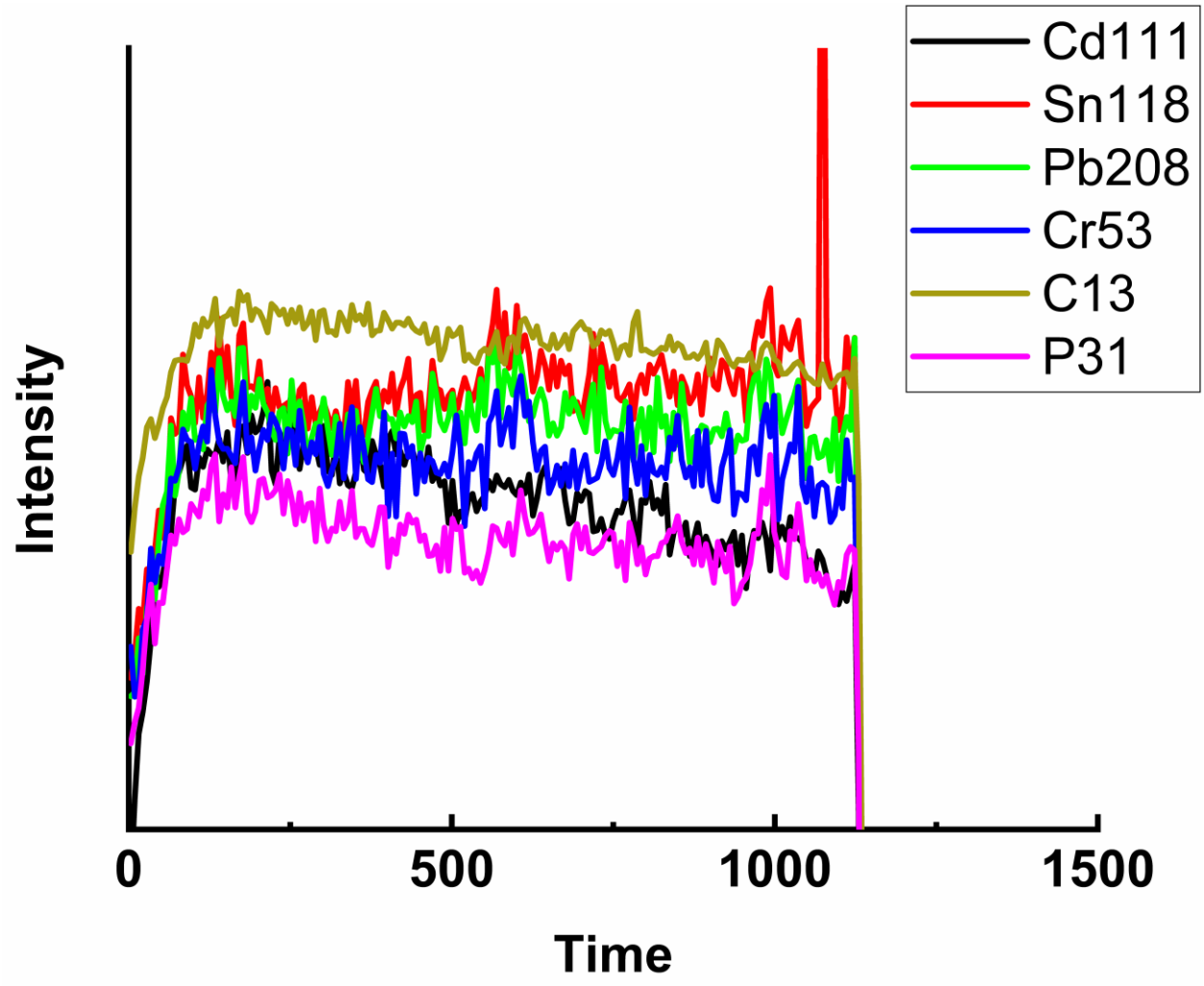

Figure S2. Typical signal fluctuations for C, P, Cr, Cd, Sn and Pb in the line scan mode with a 213 nm laser ablation system. Signal intensities were unified to 5×10^5 counts per second (cps) to easily compare the differences between elements.

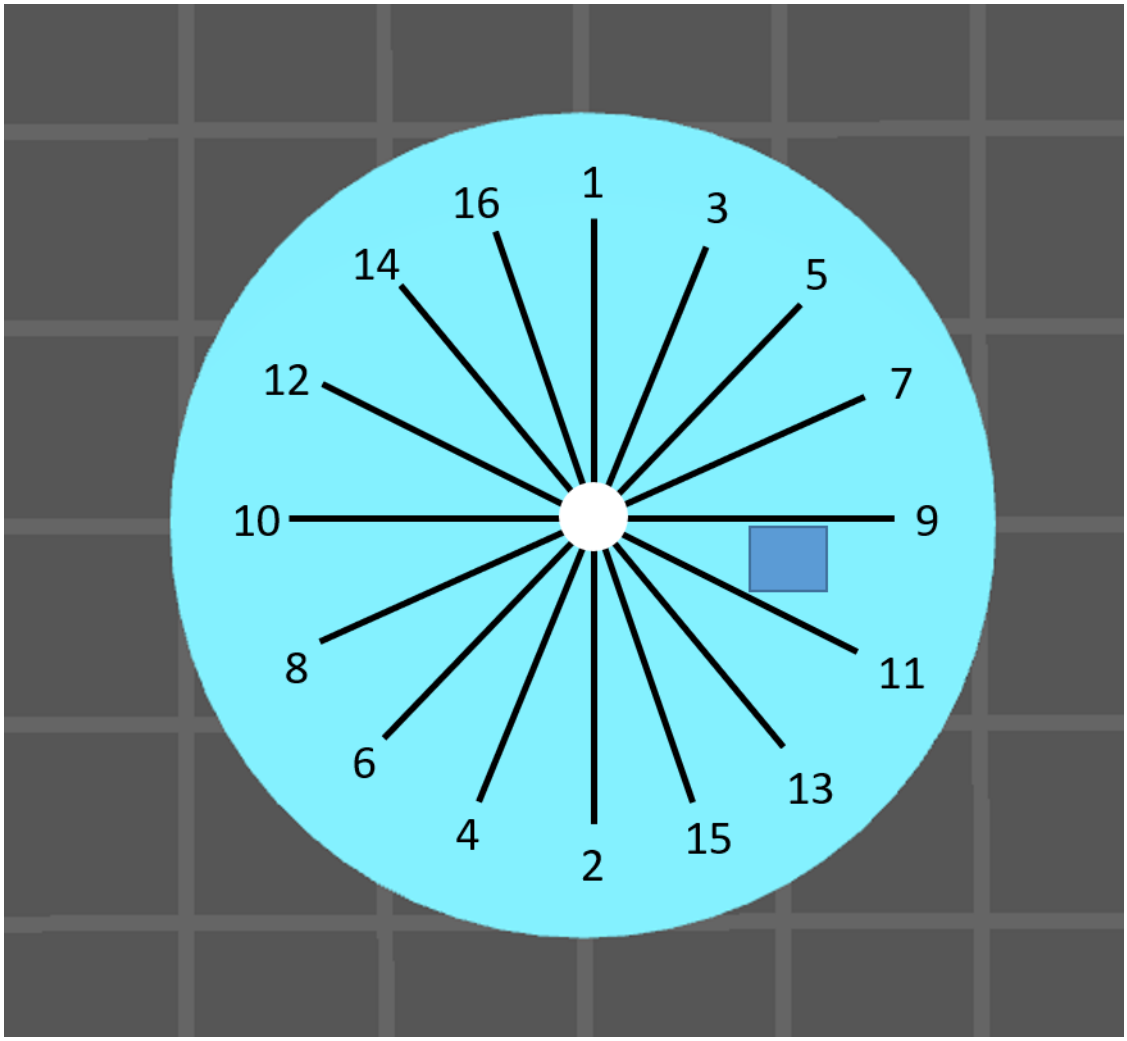

Figure S3. Schematic diagram of the homogeneity evaluation. Line scans are performed in the order of the serial numbers (1-16). The rectangle on the right shows the location of the smaller scale mapping analysis.

Table S1. Information to prepare the original solutions of Cr, Cd and Pb

Element	Mass of the particles(g)	Acids	Mass of original solution(g)	Mass concentration (mg g-1) (k =1)
Pb	1.9609(5)	5ml 2N HNO3 +0.8ml 12N HNO3	24.4971(5)	80.05(8)
Cd	1.9418(5)	10ml 2N HNO3 +1.25ml 12N HNO3	24.2047(5)	80.22(8)
Cr	1.1712(5)	9ml 10.5M HCl	19.4226(5)	60.29(6)

Table S2. Optimized printing parameters for photocurable resin samples (with Chitubox software)

3D printing related parameters	
Machine Type	PhrozenSonic Mini 4K
Mirror	LCD mirror
Layer Height	0.025 mm
Bottom Layer Count	4 layers
Transition Layer Count	0 layers
Bottom/Common single layer exposure time	50/35 s (50/20 for pure FLGPCL04)
Bottom/Common single layer light-off delay	0/0 s
Bottom/Common single layer lift distance	5/5 mm
Bottom/Common single layer lift speed	65/30 mm min^{-1}
Retract Speed	150 mm min^{-1}
Bottom/Common light Pulse Width Modulation (PWM)	255/255

Table S3. Optimized parameters of the ICP-MS and LA-ICP-MS analysis

ICP-MS	
Nebulizer Gas Flow (L min^{-1})	1.06 (1.16 for LA)
Auxiliary Gas Flow (L min^{-1})	1.2
Plasma Gas Flow (L min^{-1})	18
ICP RF Power (W)	1450
Sweeps per reading	30 (1 for LA)
Reading per replicate	1 (variable for LA)
Replicate	6 (1 for LA)
Integration interval (ms)	150
Isotopes monitored	^{53}Cr, ^{111}Cd, ^{208}Pb
Laser ablation system (213nm)	
Scan Mode	Line scan
Spot Size (μm, Circle)	100
Scan speed (μm s^{-1})	15
Repetition Rate (Hz)	10
Energy setting	100% (20.39J cm^{-2})
Laser ablation system (193nm)	
Scan Mode	Line scan
Spot Size (μm, Circle)	50
Scan speed (μm s^{-1})	30/15
Repetition Rate (Hz)	20
Energy setting	4 J cm^{-2}

Table S4. Weights of the reagents to prepare the mixture and final mass concentration (*k*=1)

Reagents	Added weight (g)	Mass Concentration (μg g-1)
PEGDA-575	51.569(5)	/
Original Solution of Pb	0.1379(5)	107.3(2)
Original Solution of Cd	0.1200(5)	93.6(2)
Original Solution of Cr	0.1769(5)	103.7(2)
FLGPCL04	50.847(5)	/

Table S5. Uncertainty evaluation of concentrations of Pb, Cd and Cr during ID-ICP-MS process in the printed sample.

Pb				
Quantity	Value	Standard Uncertainty	Uncertainty Contribution	
M_x	0.10444	289E^-6	-0.3	12.40%
C_y	4.0099	8.08E^-3	0.22	6.60%
$R_{Y206/207}$	0.015527	93.3E^-6	-0.16	3.70%
$R_{XY208/207}$	1.03347	3.57E^-3	0.72	73.60%
C_x (Pb)	106.948	0.838		k=1
Cd				
Quantity	Value	Standard Uncertainty	Uncertainty Contribution	
M_x	0.10083	289E^-6	-0.27	12.10%
C_y	6.3017	0.0122	0.18	5.50%
$R_{Y113/111}$	4.60580E^-3	8.81E^-6	0.24	9.50%
$R_{X113/111}$	1.01663	1.38E^-3	-0.17	4.80%
$R_{XY113/111}$	0.31647	1.04E^-3	0.45	34.20%
$R_{YB113/111}$	4.6088E^-3	13.9E^-6	-0.41	29.00%
C_x (Cd)	92.94	0.764		k=1
Cr				
Quantity	Value	Standard Uncertainty	Uncertainty Contribution	
$R_{XY52/53}$	0.59231	3.45E^-3	0.69	18.40%
M_x	0.10739	289E^-6	-0.28	3.00%
$R_{Z52/53}$	8.6075	0.0811	0.22	1.90%
$R_{Z54/53}$	0.2679	0.0228	-0.23	2.00%
$R_{N52/53}$	8.6194	0.0812	0.88	30.30%
$R_{N54/53}$	0.2561	0.0218	0.23	2.00%
$R_{NB52/53}$	8.5539	0.0612	-0.85	27.90%
$R_{NB54/53}$	0.2463	0.021	-0.22	1.80%
$R_{ZY52/53}$-1	0.51747	4.88E^-3	-0.19	1.40%
$R_{ZY52/53}$-2	0.49878	4.70E^-3	-0.18	1.30%
$R_{ZY52/53}$-3	0.4992	4.70E^-3	-0.19	1.30%
$R_{ZY52/53}$-4	0.49893	4.70E^-3	-0.19	1.30%
$R_{ZY52/53}$-5	0.49372	4.65E^-3	-0.19	1.40%
$R_{ZY52/53}$-6	0.49723	4.69E^-3	-0.19	1.40%
C_x (Cr)	103.07	1.6		k=1

Among them, R_Z, R_N, R_{NB}, R_{XY}, R_{ZY}, C_y and M_x represent the ratio measurement results of known concentration standard, isotopic CRM, isotopic CRM in the resin matrix, sample + spike and six parallel concentration standard solution + spike, concentration of spike solutions and mass of printed samples, respectively.