Table S1. Particle number emission yields (#/g printed) during printing for five vat polymerization 3-D printers (P-Trak data)

Trial	Form 1+ (SLA)	Pegasus Touch (SLA)	Nobel 1.0A (SLA)	Titan 1 (DLP)	M-One (DLP)
1	5.0×10^8	1.3×10^8	7.1×10^8	9.0×10^8	3.4×10^8
2	3.6×10^8	1.6×10^8	3.2×10^8	6.4×10^8	5.8×10^8
3	1.8×10^8	1.1×10^8	2.8×10^8	6.2×10^8	3.0×10^8
4	1.8×10^8	8.7×10^7	1.8×10^8	1.3×10^9	2.0×10^8
5	1.2×10^8	1.5×10^8	1.8×10^8	1.1×10^9	2.2×10^8
Mean	2.7×10^8	1.3×10^8	2.8×10^8	9.2×10^8	3.3×10^8
StDev	1.6×10^8	3.1×10^7	2.6×10^8	3.0×10^8	1.5×10^8
CV (%)	59.3	23.9	66.4	33.1	46.3

CV = coefficient of variation

Table S2. Size-resolved number emission yields (# 5.6 to 560 nm/g printed) during printing for five vat polymerization 3-D printers (FMPS data)

Trial	Form 1+ (SLA)	Pegasus Touch (SLA)	Nobel 1.0A (SLA)	Titan 1 (DLP)	M-One (DLP)
1	1.5×10^{10}	8.3×10^{9}	3.6×10^{10}	3.2×10^{10}	1.4×10^{10}
2	1.3×10^{10}	7.7×10^{9}	2.1×10^{10}	3.3×10^{10}	1.5×10^{10}
3	1.2×10^{10}	8.7×10^{9}	1.8×10^{10}	2.9×10^{10}	1.1×10^{10}
4	1.3×10^{10}	6.3×10^{9}	1.5×10^{10}	5.6×10^{10}	7.8×10^{9}
5	1.0×10^{10}	7.2×10^{9}	1.6×10^{10}	5.2×10^{10}	8.8×10^{9}
Mean	1.3×10^{10}	7.6×10^{9}	2.1×10^{10}	4.0×10^{10}	1.1×10^{10}
StDev	1.7×10^{9}	9.4×10^{8}	8.6×10^{9}	1.2×10^{10}	3.2×10^{9}
CV (%)	13.4	12.3	41.0	30.7	28.1

CV = coefficient of variation

Table S3. Average geometric mean (nm) and geometric standard deviation (GSD) of particle sizes emitted during printing by five vat polymerization 3-D printers (FMPS data)

Form 1+		Pegasus Touch		Nobel 1.0A		Titan 1		M-One	
GM	GSD	GM	GSD	GM	GSD	GM	GSD	GM	GSD
41.5	1.6	45.5	1.7	48.6	1.3	17.6	1.5	19.2	1.3
42.3	1.7	49.3	1.8	46.0	1.6	16.2	1.4	25.9	1.6
40.4	1.7	23.0	2.0	46.5	1.7	14.9	1.4	35.3	1.5
44.9	1.8	43.2	1.7	42.4	1.7	13.3	1.2	31.3	1.6
37.6	1.7	44.3	1.8	42.0	1.7	14.4	1.3	32.3	1.6
41.3[a]	1.7[b]	41.1	1.8	45.1	1.6	15.3	1.4	28.8	1.5

[a] Mean GM (nm)

[b] Mean GSD

Table S4. TVOC emission yields (µg/g printed) during printing for five vat polymerization 3-D printers

Trial	Form 1+ (SLA)	Pegasus Touch (SLA)	Nobel 1.0A (SLA)	Titan 1 (DLP)	M-One (DLP)
1	326.4	131.6	202.6	1601.1	2183.5
2	260.1	152.3	482.9	1159.8	1656.4
3	160.1	148.2	155.4	1542.3	1884.1
4	262.1	128.1	642.3	825.8	2160.7
5	376.7	243.4	125.2	1273.7	1771.1
Mean	277.1	161.7	321.7	1280.5	1931.2
StDev	85.1	47.4	228.7	313.3	234.4
CV (%)	29.4	29.5	71.1	24.5	12.1

CV = coefficient of variation

Table S5. Elemental content of bulk grey liquid resins and printed solid objects by ICP analysis (mg/kg)

		Formlabs†		Alchemy Universal	Spot HT	XYZ Printing
Element	State*	M-One	Form 1+	Pegasus Touch	Titan 1	Nobel 1.0A
Aluminum	Resin	3.6		3.3	21.3	20.8
	Object[1]	51.8±25.0	52.0±11.7	83.1±1.25	43.5±3.97	70.1±9.47
Antimony	Resin	1.0		16.0	<LOD	<LOD
	Object[2]	0.36±0.11	0.28±0.02	81.9±10.3	0.86±0.03	0.41±0.15
Arsenic	Resin	<LOD		<LOD	<LOD	<LOD
	Object[1]	0.20±0.03	0.15±0.01	0.17±0.01	0.14±0.01	0.17±0.02
Barium	Resin	<LOD		10.56	<LOD	<LOD
	Object[2]	<LOD	<LOD	30.1±0.74	<LOD	<LOD
Cadmium	Resin	<LOD		<LOD	<LOD	<LOD
	Object[1]	0.31±0.04	(0.06)±0.03[3]	0.11±0.02	0.08±0.02	0.10±0.01
Calcium	Resin	<LOD		<LOD	<LOD	<LOD
	Object[2]	84.6±36.7	123.4±34.0	44.7±5.79	46.1±14.2	63.4±9.88
Chromium	Resin	2.3		4.8	12.1	2.4
	Object[2]	11.4±0.74	5.21±0.97	13.0±3.85	26.2±0.73	9.2±2.11

		Formlabs[†]		Alchemy Universal	Spot HT	XYZ Printing
Element	State*	M-One	Form 1+	Pegasus Touch	Titan 1	Nobel 1.0A
Cobalt	Resin	<LOD		<LOD	<LOD	<LOD
	Object[2]	88.5±16.9	9.40±5.86	91.3±54.5	15.3±9.03	37.4±2.09
Copper	Resin	<LOD		<LOD	4.73	<LOD
	Object[2]	32.9±22.7	10.3±5.31	77.6±78.7	2.85±1.96	1.36±0.34
Iron	Resin	<LOD		<LOD	<LOD	<LOD
	Object[1]	135.7±17.7	88.7±17.0	79.9±21.4	76.4±12.8	77.1±6.77
Lead	Resin	<LOD		<LOD	36.45	ND
	Object[2]	1.76±0.66	2.17±0.14	0.87±0.20	81.3±3.64	0.71±0.39
Manganese	Resin	<LOD		<LOD	<LOD	<LOD
	Object[2]	5.23±0.59	3.45±1.72	2.18±0.36	1.46±0.18	3.54±0.44
Molybdenum	Resin	<LOD		<LOD	<LOD	<LOD
	Object[2]	0.24±0.04	0.10±0.03	0.16±0.01	0.14±0.14	0.09±0.02
Nickel	Resin	<LOD		<LOD	<LOD	<LOD
	Object[2]	84.3±5.73	14.9±10.5	52.5±40.5	18.5±6.34	43.4±32.5
Phosphorous	Resin	551.1		342.0	396.4	686.1

		Formlabs[†]		Alchemy Universal	Spot HT	XYZ Printing
Element	State*	M-One	Form 1+	Pegasus Touch	Titan 1	Nobel 1.0A
	Object[2,4]	477.1±9.89	458.59±35.7	655.1±9.66	386.2±11.0	749.8±44.0
Tin	Resin	51.91		126.15	22.63	44.24
	Object[2]	77.3±1.11	63.5±0.71	120.2±3.32	54.9±1.88	51.1±0.54
Titanium	Resin	3.36		0.73	4.79	3.06
	Object[1]	5.78±0.24	5.85±0.19	2.88±0.19	7.04±0.24	3.69±0.28
Vanadium	Resin	<LOD		<LOD	<LOD	<LOD
	Object[1]	0.88±0.11	0.29±0.02	0.50±0.10	0.43±0.08	0.67±0.05
Zinc	Resin	<LOD		<LOD	<LOD	<LOD
	Object[1]	24.4±5.03	14.09±4.11	11.3±1.99	11.3±4.79	12.9±2.17

* n = 1 sample for bulk liquid resin, n = 3 samples for solid printed objects

† Formlabs resin used in Form 1+ and M-One printers

1 Results were obtained using helium gas collision mode

2 Results were obtained using no gas standard mode

3 ( ) = between LOD and LOQ

4 Results were above the calibration curve

Table S6. Concentrations of carbonyl compounds (ppb) emitted by vat polymerization 3-d printers

	Acetone[a]		Benzaldehyde[b]		4-oxopentanal[c]	
3-d printer	Print	Post-print	Print	Post-print	Print	Post-print
Form 1+ (SLA)	1.46	1.21	1.22	1.44	<LOD	<LOD
Pegasus Touch (SLA)	0.67	0.87	0.96	0.93	<LOD	<LOD
Nobel 1.0A (SLA)	18.1	26.0	3.30	3.24	<LOD	0.07
Titan 1 (DLP)	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
M-One (DLP)	0.73	2.23	12.26	12.69	<LOD	<LOD

[a] limit of detection (LOD) = 0.13 ppb; limit of quantification (LOQ) = 1.34 ppb

[b] LOD = 0.13 ppb, LOQ = 1.27 ppb

[c] LOD = 0.05 ppb, 0.47 ppb

Table S7. Summary of literature on emission yields and particle size data for various additive manufacturing processes

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	ABS/--	45 m^3 room	SMPS	15 – 49	--	Ref(1)
ME	ABS/brown	1 m^3 chamber	SMPS	33	2×10^{11}	Ref(2)
ME	ABS/various	60 m^3 clean room	OPC	250 – 280	--	Ref(3)
ME	ABS/yellow	0.085 m^3 chamber	ASM	60 – 90	2×10^{9}	Ref(4)
ME	ABS/various	0.5 m^3 chamber	SMPS	45 – 79	$3 – 6 x10^{10}$	Ref(5)
ME	ABS filament	162 m^3 room	SMPS	34	--	Ref(6)
ME	ABS/various	3.6 m^3 chamber	CNC	n.a.	$2 x 10^{11}$	Ref(7),d
ME	ABS/red	0.025 m^3 chamber	SMPS	47	$4 x 10^{7}$	Ref(8)
ME	ABS/grey	2.5 m^3 chamber	SMPS	46 – 58	$1 – 2 x 10^{11}$	Ref(9)
ME	ABS/red	0.18 m^3 chamber	SMPS	9 – 13	--	Ref(10)
ME	ABS/various	1 m^3 chamber	SMPS	40 – 118	$5 x 10^{8} – 1 x 10^{11}$	Ref(11)

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	ABS/various	0.5 m^3 chamber	SMPS	51 – 51	1 – 6 x 10^{11}	Ref[(12)]
ME	ABS filament	12.85 m^3 chamber	FMPS	21 – 24	3.1 x 10^{12}	Ref[(13)]
ME	ABS_{mwcnt} filament	12.85 m^3 chamber	FMPS	29 – 35	1.6 x 10^{11}	Ref[(13)]
ME	CP/n.r.	40 m^3 room	SMPS	16	2 x 10^{12}	Ref[(14),e]
ME	CP/carbon infill	40 m^3 room	SMPS	17	2 x 10^{12}	Ref[(14),e]
ME	HIPS/black	3.6 m^3 chamber	CNC	n.a.	1 x 10^{10}	Ref[(7)]
ME	HIPS/white	0.025 m^3 chamber	SMPS	56	0.9 x 10^7	Ref[(8)]
ME	HIPS/white	2.5 m^3 chamber	SMPS	32	2 x 10^{12}	Ref[(9)]
ME	Laywood/white	3.6 m^3 chamber	CNC	n.a.	2 x 10^8	Ref[(7)]

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	Laywood/brown	2.5 m^3 chamber	SMPS	--	2×10^9	Ref(9)
ME	Laybrick/brown	3.6 m^3 chamber	CNC	n.a.	2×10^8	Ref(7)
ME	Nylon/semi-trans	3.6 m^3 chamber	CNC	n.a.	8×10^8	Ref(7)
ME	Nylon/white	0.025 m^3 chamber	SMPS	56	2×10^7	Ref(8)
ME	Nylon/white	2.5 m^3 chamber	SMPS	22	2×10^{12}	Ref(9)
ME	Nylon/natural	1 m^3 chamber	SMPS	129	2×10^9	Zhang et al., 2017
ME	PC/transparent	3.6 m^3 chamber	CNC	n.a.	1×10^{11}	Ref(7)
ME	PCABS/natural	0.025 m^3 chamber	SMPS	42	1×10^8	Ref(8)
ME	PC filament	12.85 m^3 chamber	FMPS	41 – 58	9.7×10^{11}	Ref(13)
ME	PC_{mwcnt} filament	12.85 m^3 chamber	FMPS	23 – 28	1.1×10^{12}	Ref(13)

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	PCTPE/semi-trans	3.6 m^3 chamber	CNC	n.a.	8×10^{10}	Ref[7]
ME	PET	0.025 m^3 chamber	SMPS	41	3×10^{7}	Ref[8]
ME	PLA/green	45 m^3 office	SMPS	48 – 65	--	Ref[1]
ME	PLA/various	1 m^3 chamber	SMPS	28 – 188	$4 – 4 \times 10^{9}$	Ref[2]
ME	PLA/--	40 m^3 room	SMPS	15	8×10^{10}	Ref[14],[e]
ME	PLA/wood infill	40 m^3 room	SMPS	13	9×10^{11}	Ref[14],[e]
ME	PLA/copper infill	40 m^3 room	SMPS	24	7×10^{12}	Ref[14],[e]
ME	PLA/bamboo infill	40 m^3 room	SMPS	21	2×10^{12}	Ref[14],[e]
ME	PLA/yellow	0.085 m^3 chamber	ASM	20 – 30	2×10^{10}	Ref[4]

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	PLA/various	0.5 m^3 chamber	SMPS	28 – 32	3 – 5 x 10^{10}	Ref[(5)]
ME	PLA/various	3.6 m^3 chamber	CNC	n.a.	6 – 8 x10^8	Ref[(7)]
ME	PLA/orange	0.025 m^3 chamber	SMPS	45	0.2 x 10^7	Ref[(8)]
ME	PLA/bronze infill	0.025 m^3 chamber	SMPS	42	2 x10^8	Ref[(8)]
ME	PLA/red	2.5 m^3 chamber	SMPS	57	1 x 10^9	Ref[(9)]
ME	PLA/orange	0.18 m^3 chamber	SMPS	8	--	Ref[(10)]
ME	PLA/various	1 m^3 chamber	CNC	28 – 63	8 x 10^5 – 4 x 10^8	Ref[(11),f]
ME	PLA/various	0.5 m^3 chamber	SMPS	22	8 x 10^{10}	Ref[(12)]
ME	PLA/wood infill	0.5 m^3 chamber	SMPS	28	6 x 10^8	Ref[(12)]
ME	PLA/copper infill	0.5 m^3 chamber	SMPS	470	6 x 10^8	Ref[(12)]
ME	PLA filament	12.85 m^3 chamber	FMPS	18 – 29	3.6 x 10^{10}	Ref[(13)]
ME	PLA_{mwcnt} filament	12.85 m^3 chamber	FMPS	18 – 26	2.2 x 10^{10}	Ref[(13)]

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Size (nm)	Yield (# particles/g printed)	Citation
ME	PVA/natural	0.025 m^3 chamber	SMPS	83	2 x 10^9	Ref[8]
ME	PVA/natural	2.5 m^3 chamber	SMPS	68	4 x 10^9	Ref[9]
ME	T-Glase/red	3.6 m^3 chamber	CNC	n.a.	2 x 10^{10}	Ref[9]
BJ	Gypsum powder	157 m^3 lab	SMPS	205 – 255	2 – 5 x 10^3	Ref[15],[g]
PBF	Metal powder	--	OPC	>300	--	Ref[16]

[a] ME = material extrusion (FDM™); BJ = binder jetting; PBF = powder bed fusion; MJ = material jetting

[b] ABS = acrylonitrile butadiene styrene, CP = copolyester, HIPS = high-impact polystyrene; PC = polycarbonate; PCTPE = plasticized co-polyamide thermoplastic elastomer; PET = polyethylene terephthalate; PLA = poly lactic acid; PVA = poly vinyl alcohol,

[c] ASM = aerosol spectrometer; CNC = condensation nuclei counter; FMPS = fast mobility particle sizer; OPC = optical particle counter; SMPS = scanning mobility particle sizer

[d] All yield values estimated from median emission rate, print time, and object mass data reported in article

[e] All yield values estimated from emission rates at 220 °C, printed object volume, and filament density values reported in article

[f] Size values from SMPS data; yield values for PLA only calculated from CPC data

[g] All yield values estimated from emission rates and printed object volume values reported in article and feedstock powder density from safety data sheet

-- = not reported in study or could not be determined from data provided in manuscript

n.a. = not applicable for instrument used in study

Table S8. Summary of literature on total volatile organic compound (TVOC) emission yields for various additive manufacturing processes

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Yield (µg TVOC/g printed)	Reference
ME	ABS/yellow	0.085 m^3 chamber	PID	100	Ref[(4)]
ME	ABS/red	0.025 m^3 chamber	PID	782	Ref[(8)]
ME	ABS/various	0.5 m^3 chamber	PID	66 – 227	Ref[(17)]
ME	Nylon/semi-trans	3.6 m^3 chamber	GC-MS	~750	Ref[(7),d]
ME	Nylon/white	0.025 m^3 chamber	PID	664	Ref[(8)]
ME	PC/transparent	3.6 m^3 chamber	GC-MS	~9	Ref[(7),d]
ME	PCABS/natural	0.025 m^3 chamber	SMPS	850	Ref[(8)]
ME	PET	0.025 m^3 chamber	PID	492	Ref[(8)]

Process[a]	Feedstock/color[b]	Setting	Instrument[c]	Yield (µg TVOC/g printed)	Reference
ME	PLA/yellow	0.085 m^3 chamber	PID	100	Ref[4]
ME	PLA/orange		PID	545	Ref[8]
ME	PLA/bronze infill		PID	254	Ref[8]
ME	PLA/various	0.5 m^3 chamber	PID	ND – 7	Ref[17]
ME	PVA/natural	0.025 m^3 chamber	PID	583	Ref[8]

[a] ME = material extrusion (FDM™)

[b] ABS = acrylonitrile butadiene styrene, HIPS = high-impact polystyrene; PC = polycarbonate; PCTPE = plasticized co-polyamide thermoplastic elastomer; PET = polyethylene terephthalate; PLA = poly lactic acid; PVA = poly vinyl alcohol,

[c] GC-MS = gas chromatography-mass spectrometry; PID = photoionization detector

[d] All yield values estimated from median emission rates based on the sum of volatile organic compounds measured using GC-MS, print time, and object mass data reported in article

-- = not reported in study or could not be determined from data provided in manuscript

ND = non-detectable

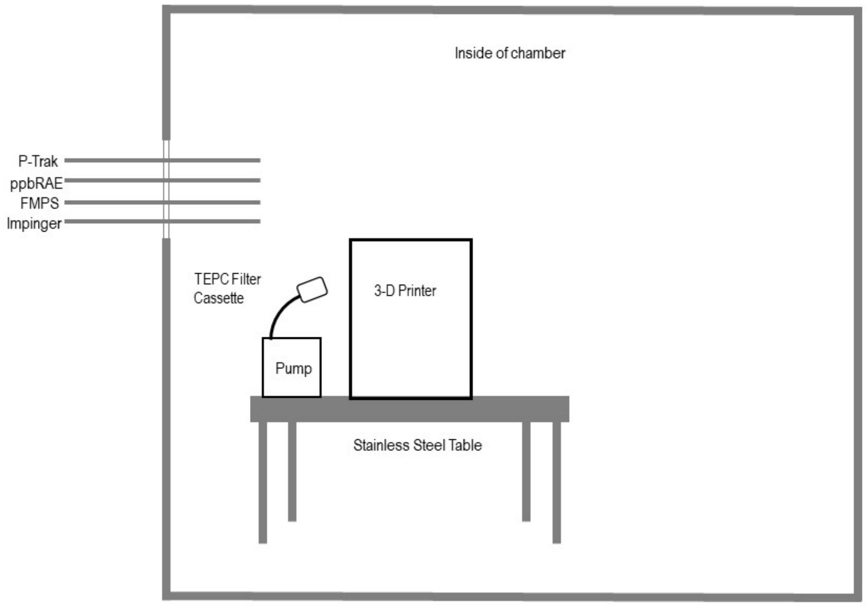

Figure S1. Schematic of emissions testing chamber setup (drawing not to scale)

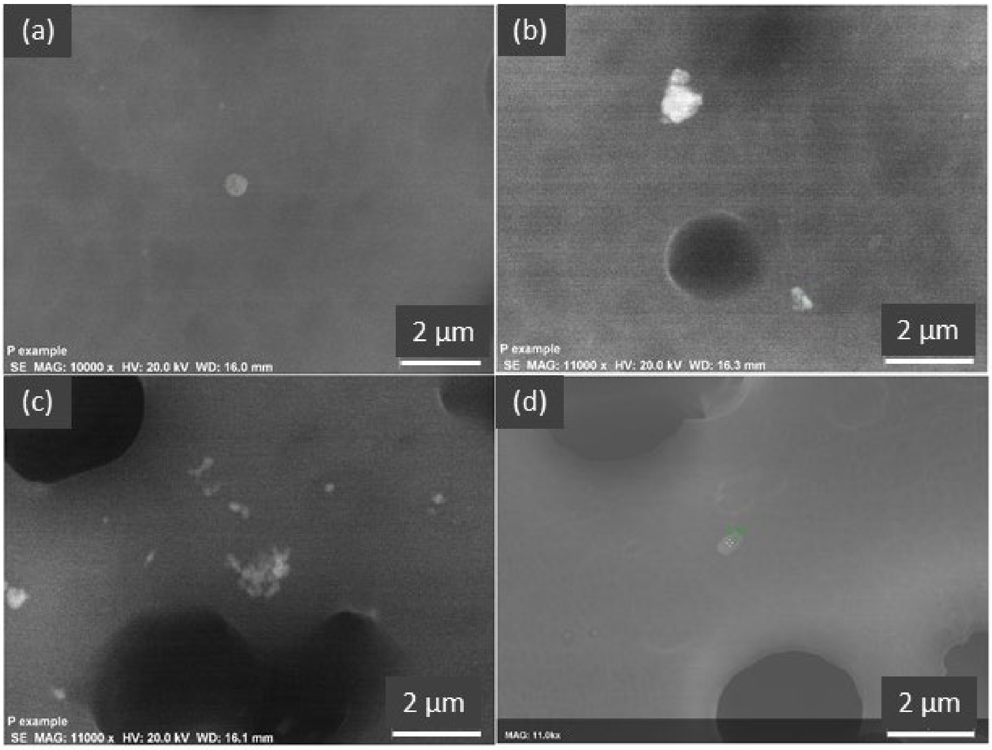

Figure S2. Morphology of particles identified in dried samples of bulk resins using field emission scanning electron microscopy: (a) Formlabs resin (Form 1+ and M-One printers), (b) Alchemy Universal resin (Pegasus Touch printer), (c) XYZPrinting resin (Nobel 1.0A printer), and (d) Spot – HT resin (Titan 1 printer).

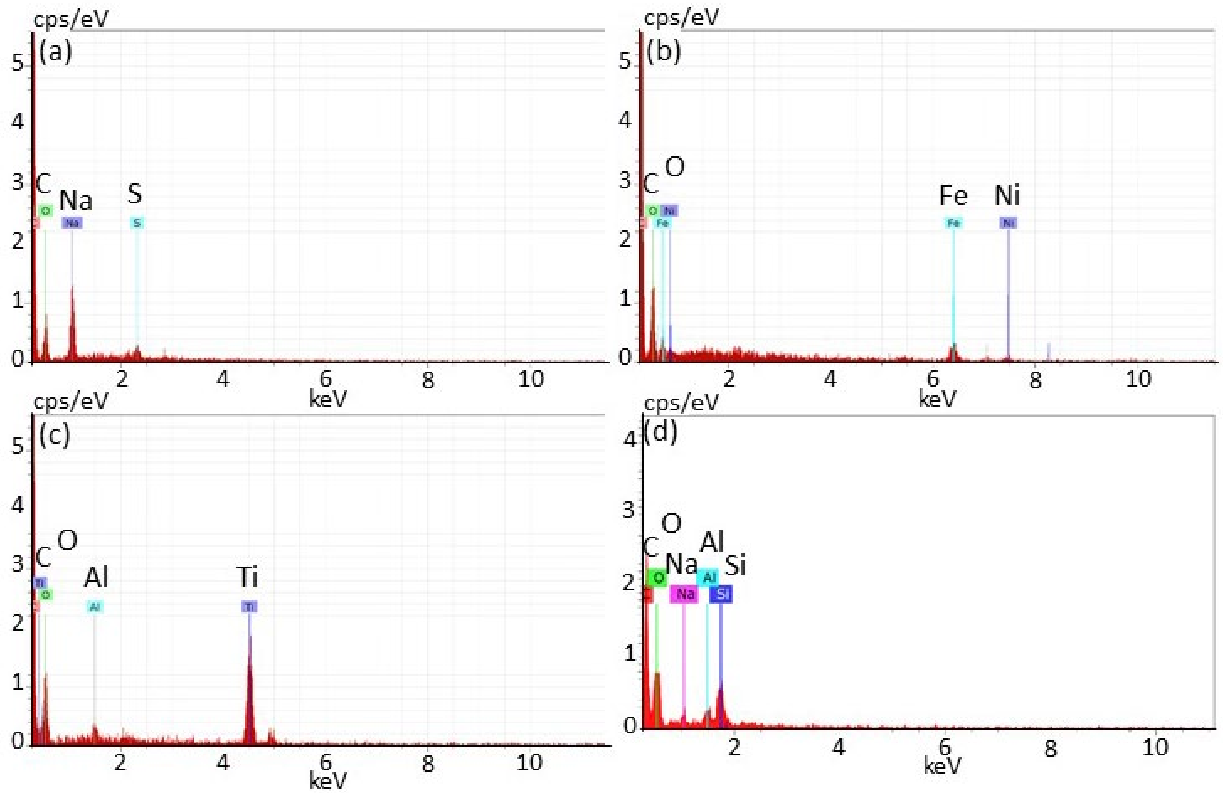

Figure S3. Elemental composition of representative particles identified in dried samples of bulk resins using field emission scanning electron microscopy with energy dispersive x-ray analysis: (a) Formlabs resin (Form 1+ and M-One printers), (b) Alchemy Universal resin (Pegasus Touch printer), (c) XYZPrinting resin (Nobel 1.0A printer), and (d) Spot – HT resin (Titan 1 printer).

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