Supporting Information

Strategy for Controlling the Properties of Bioactive Poly-Ether-Ether-Ketone/Hydroxyapatite Composites for Bone Tissue Engineering Scaffolds

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Fabricating method

To clearly illustrate the method in Figure 1, Table S1 depicts the process and methods used to create a bioactive PEEK/HA composite and a porous PEEK sample. The main process consisted of three steps: for Step 1, a porous HA scaffold was first fabricated using SEF 3D printing technology, in which the HA filament and/or pore size could be arbitrarily controlled according to different applications. For Step 2, the sintered HA scaffold was overmolded with PEEK through a compression molding process using static or dynamic loads to produce a PEEK/HA composite. For Step 3, the PEEK/HA composite was soaked in an HCl solution with a concentration of 37% for 72 hours. The HCl solution dissolved the HA network, leaving interconnected channels within the composite to in order obtain the porous PEEK sample.

Table S1 Preparation of a bioactive PEEK/HA composite and a porous PEEK

Step	Process	Method
1	Preparation of a porous HA scaffold using SEF 3D printing technology	PVB of 75% (w/v) and PEG of 25% (w/v) were fully dissolved in propan-2-ol solvent. HA powder was then added to the solution (with 60% (v/v) of ceramic based on the dried paste), and stirred for 2 hours to achieve a well-dispersed solution. Excess solvent was evaporated by fast stirring, and blowing hot air until a viscous ceramic paste was achieved. HA paste was loaded into a syringe for 3D printing. The scaffold was left at room temperature for 24 hours to allow evaporation of excess solvent, and subsequently to place the scaffold in an oven for debinding and sintering. The maximum sintering temperature for HA was 1300°C with a dwelling time of two hours. The HA bioceramic scaffold was then obtained.
2	Preparation of a PEEK/HA composite through a compression molding process	Using both static and dynamic loads to produce a PEEK/HA composite. The static loading was that the mold was heated up to 250°C then load applied until the temperature reaches 400°C, maintained for a further 20 minutes, then heating was stopped, and the mold was left to cool under pressure. The dynamic loading was that the mold was heated up to 400°C and maintained for 20 minutes. Load was applied for 5 seconds before heating was stopped, then the mold was left to cool under pressure. Composite was removed from the mold when the temperature had fallen to just below the glass transition temperature (143°C), followed by cooling to room temperature, thus mitigating thermal stress and cracking.
3	Preparation of a porous PEEK	The PEEK/HA composite was soaked in an HCl solution with a concentration of 37% for 72 hours. The HCl solution dissolved the HA network, leaving interconnected channels within the composite, the porous PEEK was obtained.

RSM experiments results

Seventeen RSM experiments were inserted into Equation Set (4), and the data for the before and after optimization models were compared with the measured values. The results of this comparison are presented in Table S2.

Table S2 RSM experiment results and comparison of two models for extrusion pressure

No	A	B	C	Extrusion pressure (MPa)			Relative error (%)	
				Measured value	Before optimization	After optimization	Before	After
1	-1	1	0	16.05	16.25	16.04	1.25	0.04
2	-1	-1	0	6.56	6.52	6.31	0.59	3.75
3	-1	0	-1	9.69	10.47	10.38	8.10	7.07
4	-1	0	1	14.78	14.86	15.01	0.56	1.57
5	0	1	-1	10.05	9.84	9.75	2.13	2.99
6	0	1	1	15.83	16.32	16.23	3.09	2.54
7	0	-1	1	6.54	7.27	7.18	11.14	9.81
8	0	-1	-1	4.45	4.48	4.39	0.58	1.37
9	0	0	0	10.93	11.19	10.90	2.35	0.25
10	0	0	0	10.93	11.19	10.90	2.35	0.25
11	0	0	0	10.93	11.19	10.90	2.35	0.25
12	0	0	0	10.93	11.19	10.90	2.35	0.25
13	0	0	0	10.93	11.19	10.90	2.35	0.25
14	1	1	0	9.59	10.14	9.94	5.77	3.61
15	1	-1	0	5.15	5.46	5.26	6.09	2.07
16	1	0	1	11.8	11.53	11.43	2.29	3.13
17	1	0	-1	6.21	6.64	6.79	6.96	9.38