Electronic Supplementary Information for the Manuscript:

One-step Synthesis of $CePO_4$ nanoparticle-Decorated Cerium-doped Ultralong Flexible Hydroxyapatite Nanofibers

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1.1 Materials

Oleic acid ($C_{18}H_{34}O_2$, AR) and Cerium (III) chloride heptahydrate ($CeCl_3 \cdot 7H_2O$, 99.9% metals basis) were purchased from Shanghai Aladdin Bio-Chem Technology Co., Ltd. (Shanghai, China). Ethanol absolute (C_2H_6O, AR), calcium chloride anhydrous ($CaCl_2$, AR), sodium hydroxide (NaOH, AR) and sodium dihydrogen phosphate dihydrate ($NaH_2PO_4 \cdot 2H_2O$, AR) were purchased from Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China). Ultrapure water was used in throughout the experiments. All reagents were used without further purification.

1.2 Characterization

The phase constituents of the as-prepared products were identified by an X-ray diffractometer (XRD, Ultima Ⅳ, RIGAKU, Japan) with a Cu Kα radiation source (λ = 1.5418 Å). The full width at half-maximum (FWHM) values and lattice parameters were obtained in Jade 6 software. The chemical compositions of the products were characterized using Fourier transform infrared spectroscopy (FTIR, Nexus 670, Thermo Nicolet, USA) with a resolution of 4 cm^{-1}. The binding energies were collected by X-ray photoelectron spectroscopy (XPS, AXIS Supra, Shimadzu, Japan) using monochromatic Al−Kα radiation (600 W). The prominent C1s peak (284.8 eV) was used to calibrate the survey and high-resolution scans of Ce3d. All XPS spectra were analyzed by the Thermo Avantage software. The surface morphologies and element distribution of the samples were obtained using field-emission scanning electron microscope (FESEM, JSM-7800F, JEOL, Japan) equipped with an energy dispersive spectrometer (EDS, X-max 80, Oxford Instruments, UK). The high-resolution TEM (HRTEM) images and selected area electron diffraction (SAED) pattern of the 6CeHANF sample were explored by a field-emission transmission electron microscope (TEM, JEM-2100, JEOL, Japan).

The crystallite sizes (D_{hkl}) of the as-prepared products were calculated by "Debey-Scherrer equation"[1, 2]. The

degree of crystallinity (X_C) was calculated using[3]:

$$X_c = \left(1 - \frac{V_{112/300}}{I_{300}}\right) \times 100\%$$

where $V_{112/300}$ was the intensity of the hollow between the (112) and (300) diffraction peaks and I_{300} was the intensity of the (300) diffraction peak.

References

1. U. Holzwarth and N. Gibson, *Nature Nanotechnology*, 2011, **6**, 534.
2. M. Ghiyasiyan-Arani, M. Salavati-Niasari and S. Naseh, *Ultrasonics Sonochemistry*, 2017, **39**, 494-503.
3. E. Landi, A. Tampieri, G. Celotti and S. Sprio, *J. Eur. Ceram. Soc.*, 2000, **20**, 2377-2387.

Table S1. Summary of characteristics of the as-prepared samples synthesized with different Ce doping ratios.

Sample	Theoretical Ce/(Ce+Ca) (at.%)	Ce/(Ce+Ca) of the product (at.%)	(Ce+Ca)/P of the product	Crystallinity (%)	Lattice parameter	
					a (Å)	*c* (Å)
0CeHANF	0	0	1.32	85.39	9.2228	7.1582
2CeHANF	2	7.60	1.21	95.94	9.2921	7.0286
4CeHANF	4	9.02	1.07	95.27	9.3685	7.0198
6CeHANF	6	14.27	1.05	92.12	9.3522	6.8836
8CeHANF	8	23.36	0.98	91.64	9.3613	6.8457

Note: Ce/(Ce+Ca) and (Ce+Ca)/P of the product were calculated based on their corresponding XPS data.

Table S2. XPS peak positions of Ce3d from the as-prepared products synthesized with different Ce doping ratios.

Sample	Ce^{3+}				Ce^{4+}					
	$3d_{5/2}$		$3d_{3/2}$		$3d_{5/2}$			$3d_{3/2}$		
2CeHANF	880.98	885.23	899.00	903.85	883.08	887.17	899.98	901.80	906.07	917.58
4CeHANF	881.36	885.45	899.42	903.92	883.29	887.35	900.42	901.79	906.23	918.02
6CeHANF	881.23	885.47	899.04	904.05	883.63	887.44	900.50	902.21	906.34	918.10
8CeHANF	881.01	885.38	898.84	904.18	883.04	887.60	900.02	901.76	906.50	917.62

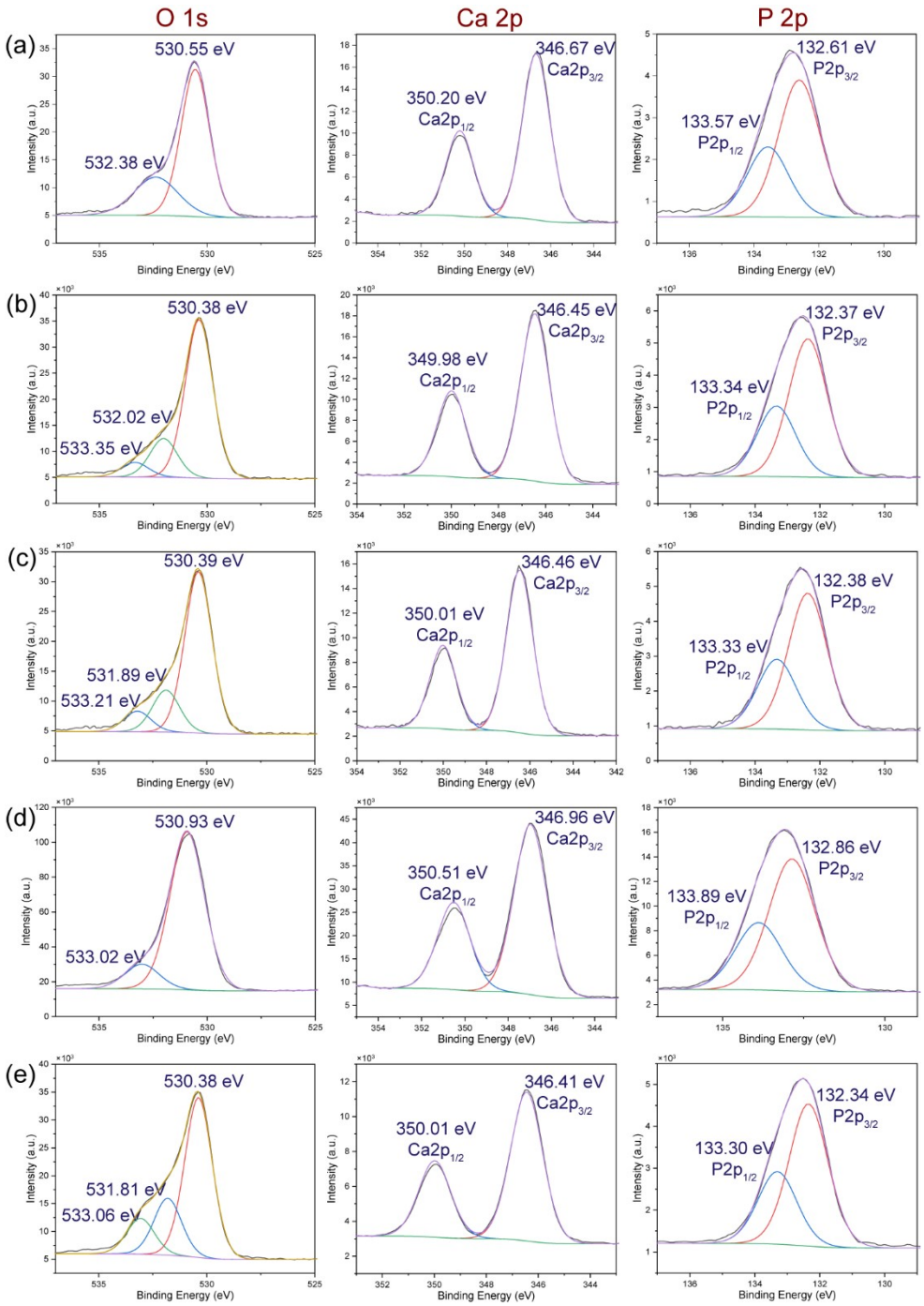

Figure S1. XPS high-resolution spectra of O1s, Ca2p, P2p of different samples. (a) 0CeHANF, (b) 2CeHANF, (c) 4CeHANF, (d) 6CeHANF, and (e) 8CeHANF.