

## Supplementary Materials

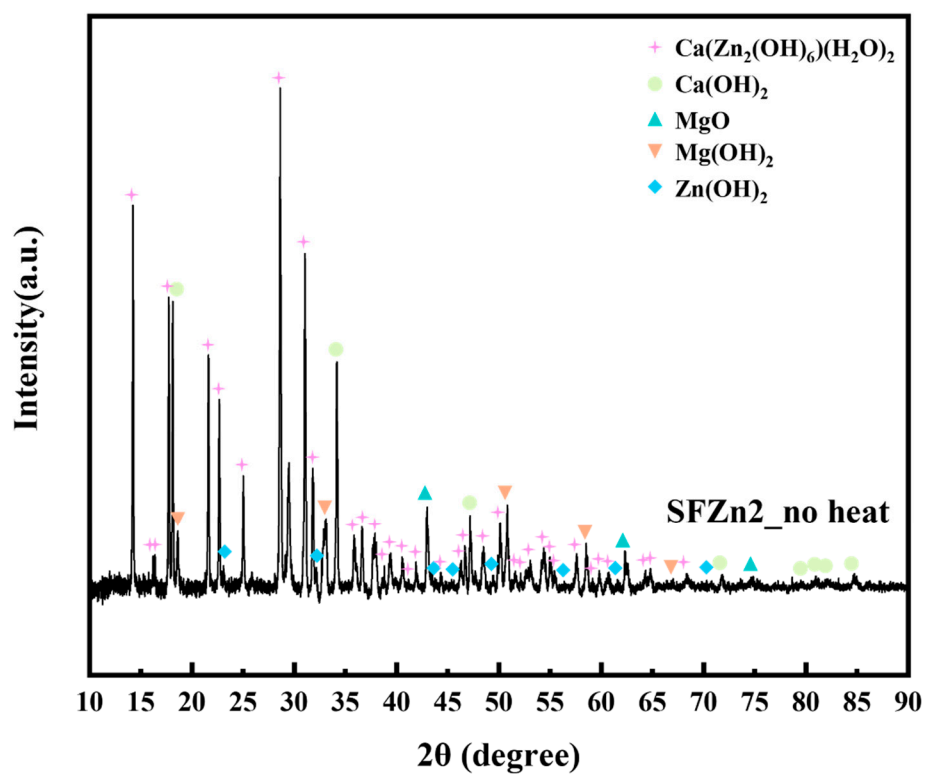
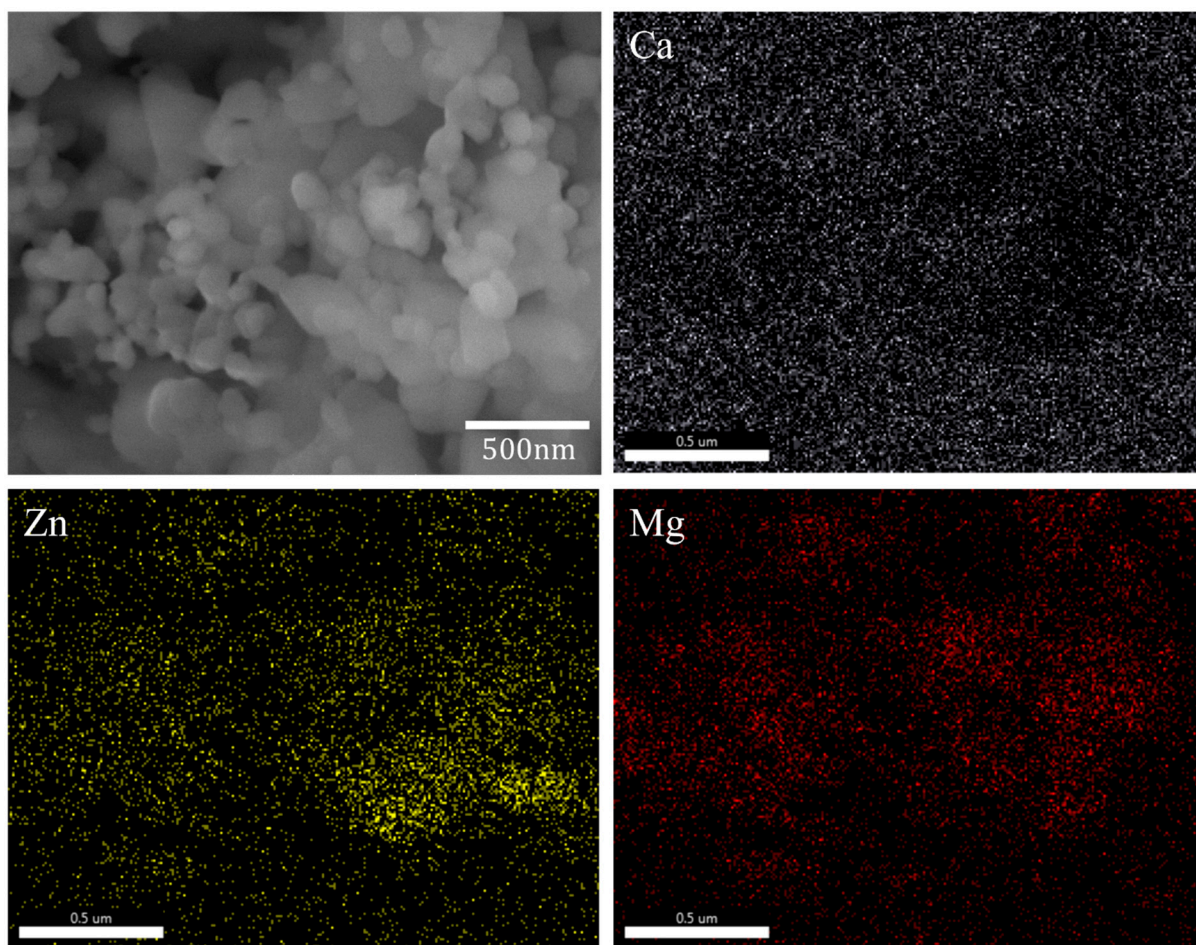
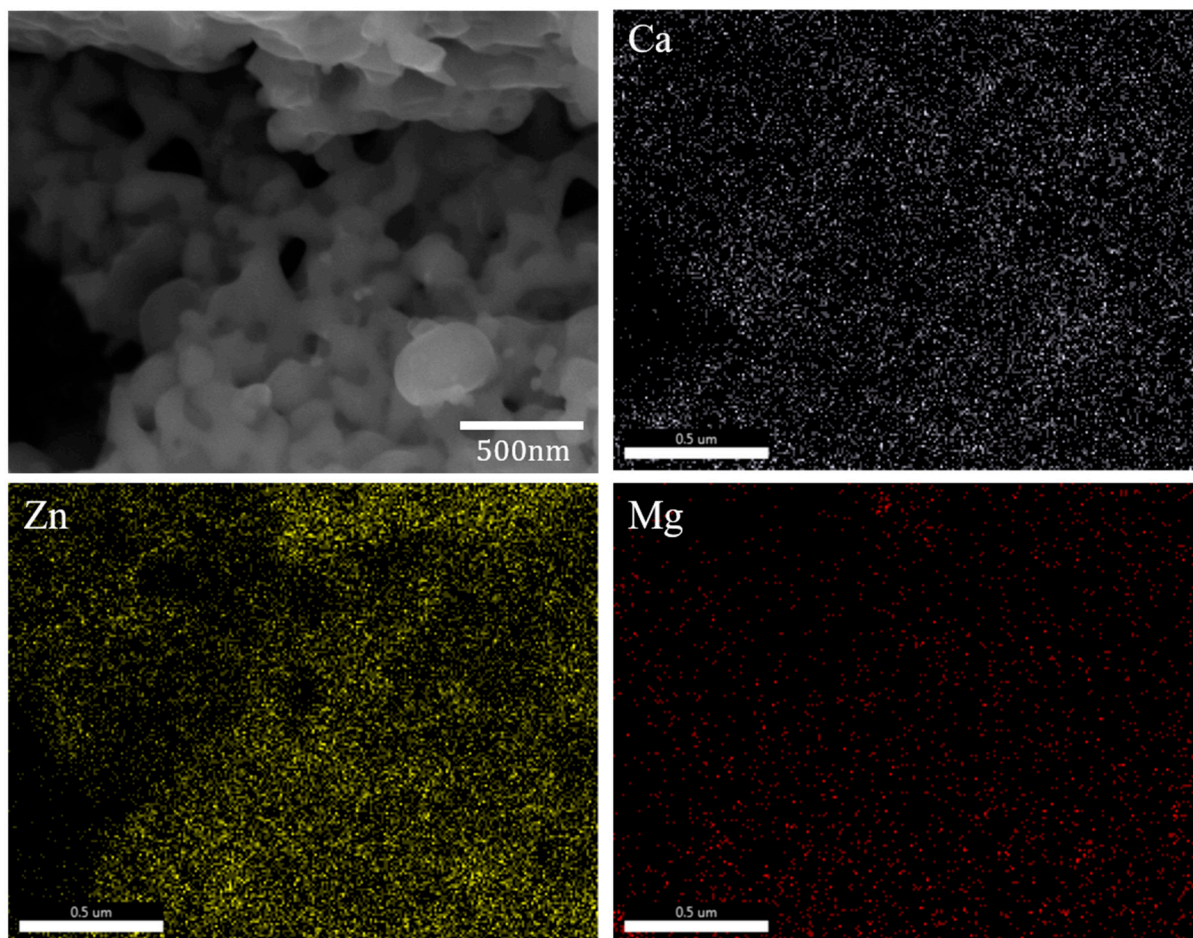


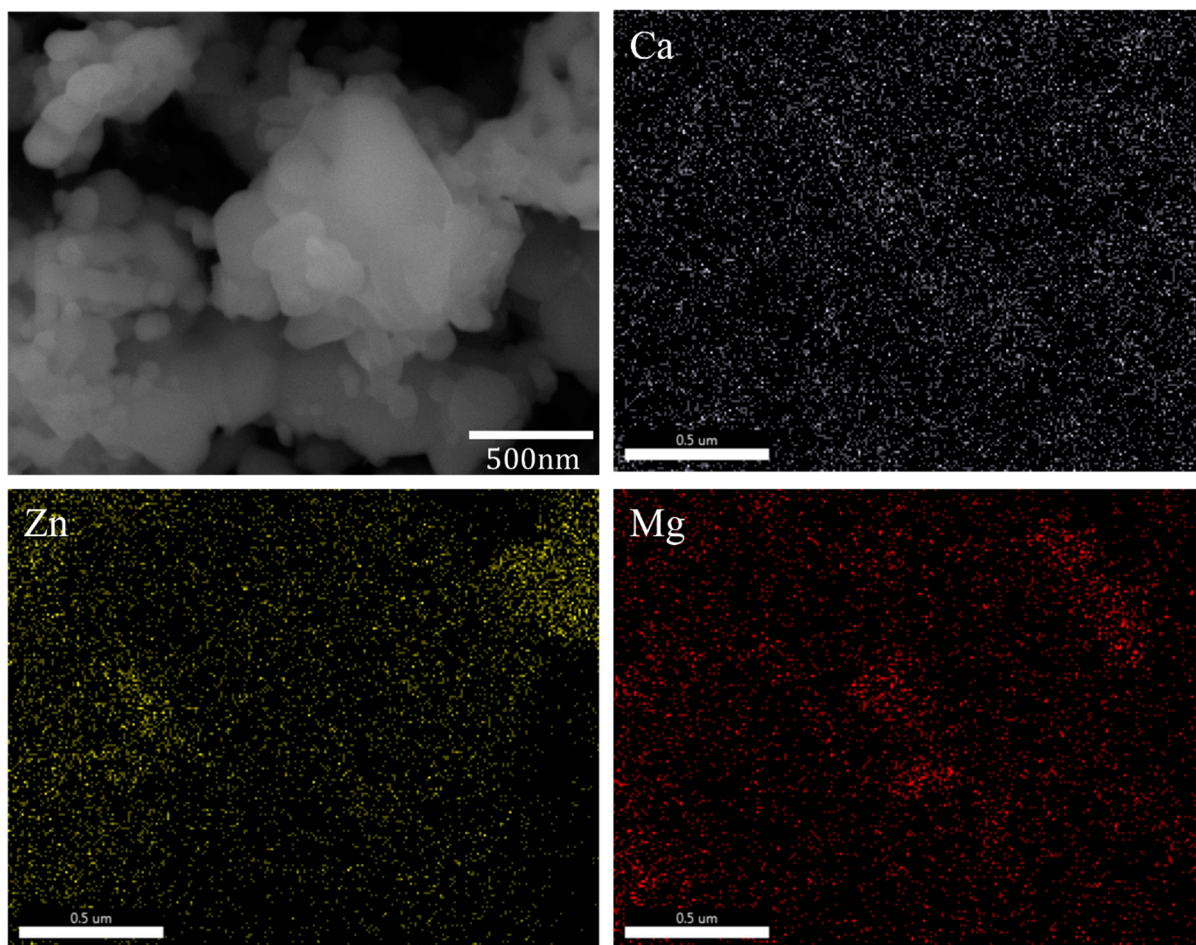
Figure S1. The XRD data of SFZn2 before heat treatment.



**Figure S2.** The EDS image of SFZn1.



**Figure S3.** The EDS image of SFZn2



**Figure S4.** The EDS image of SFZn3

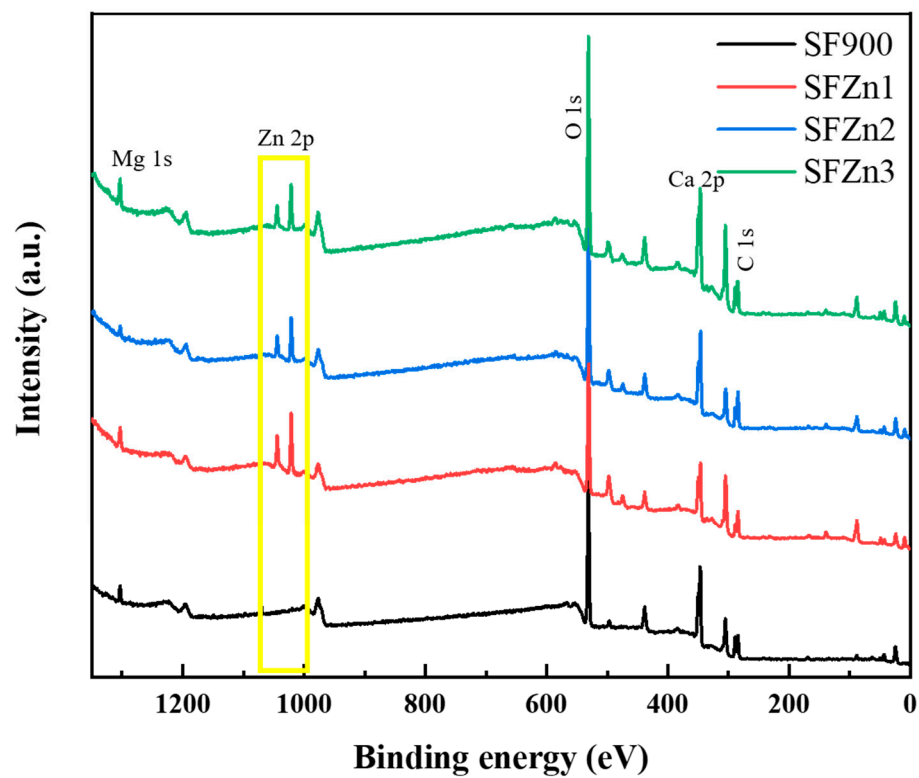
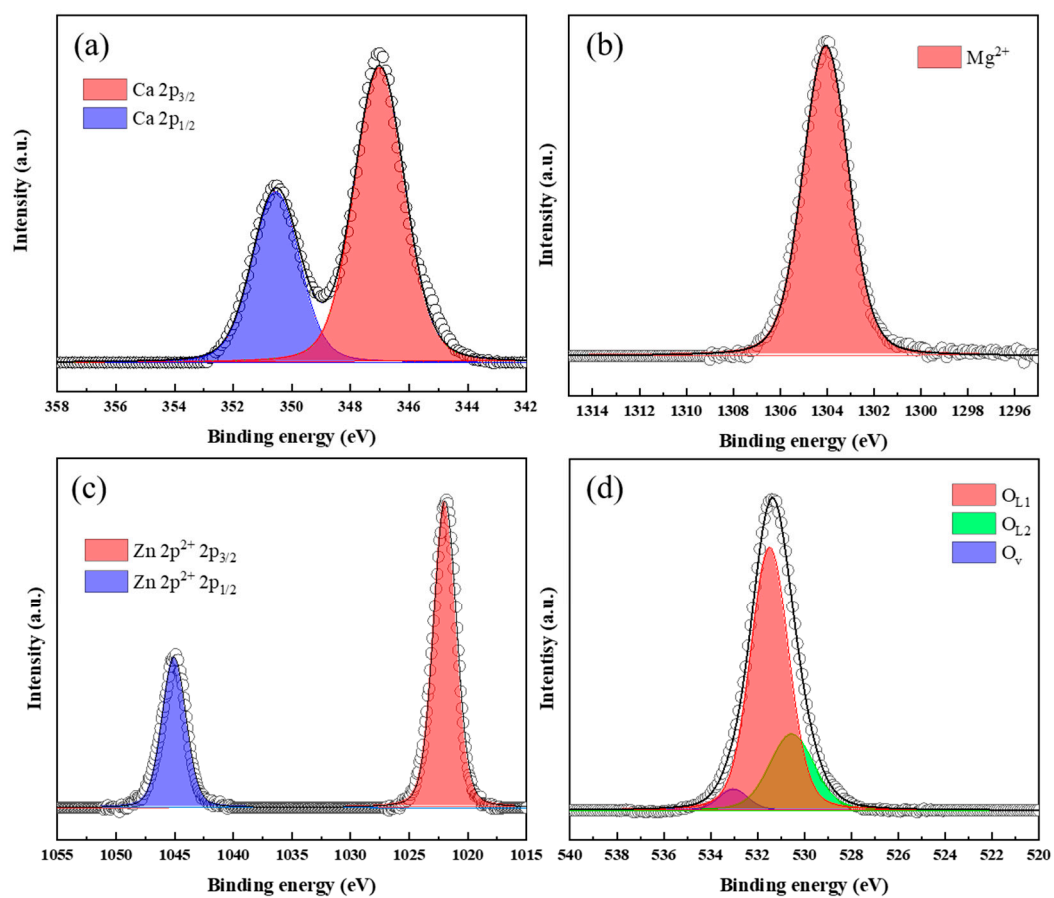
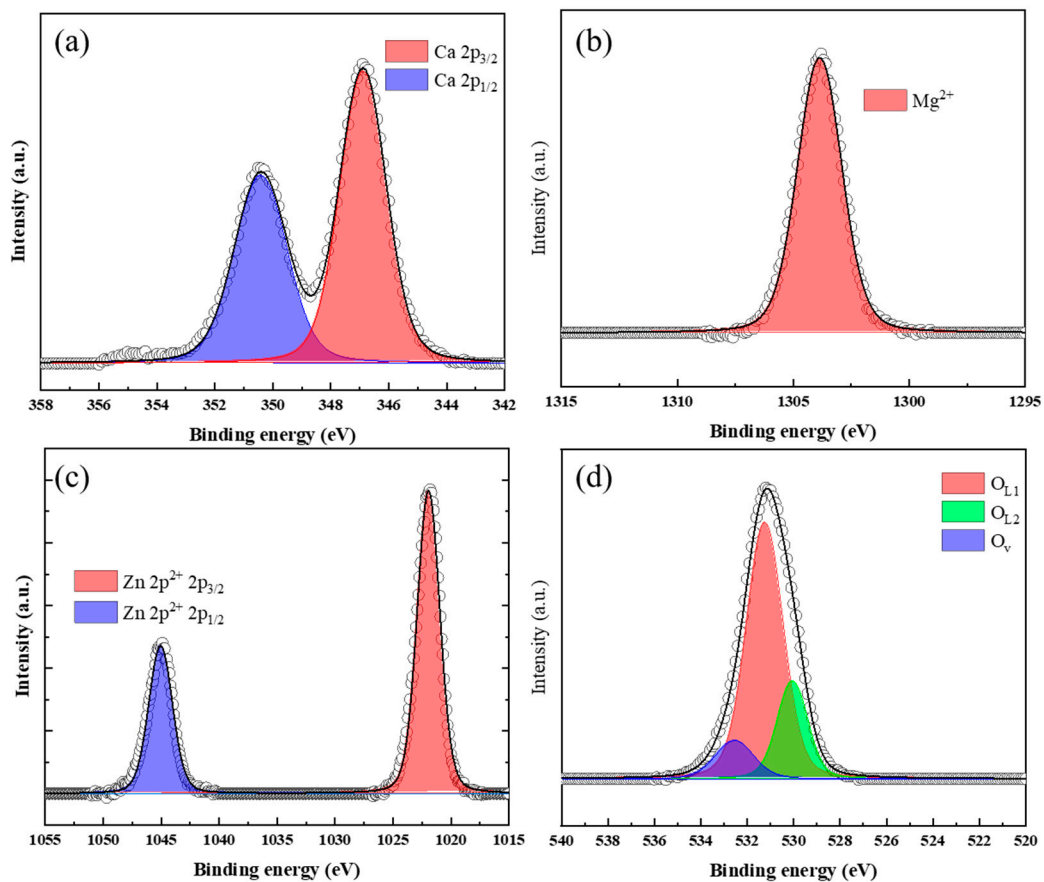


Figure S5. XPS spectra of the prepared sample

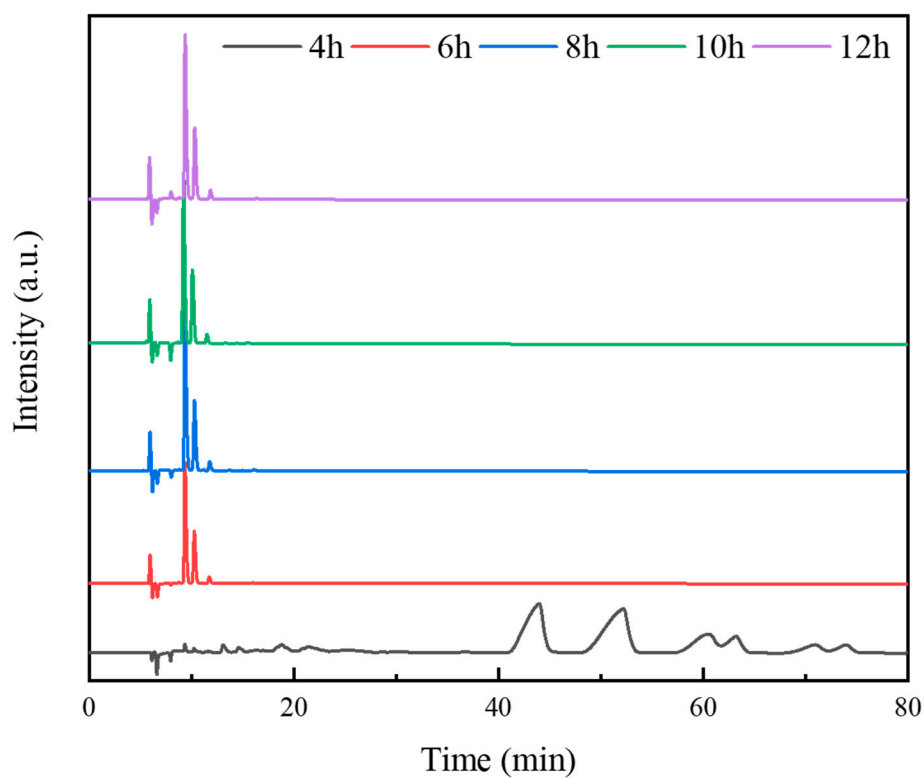




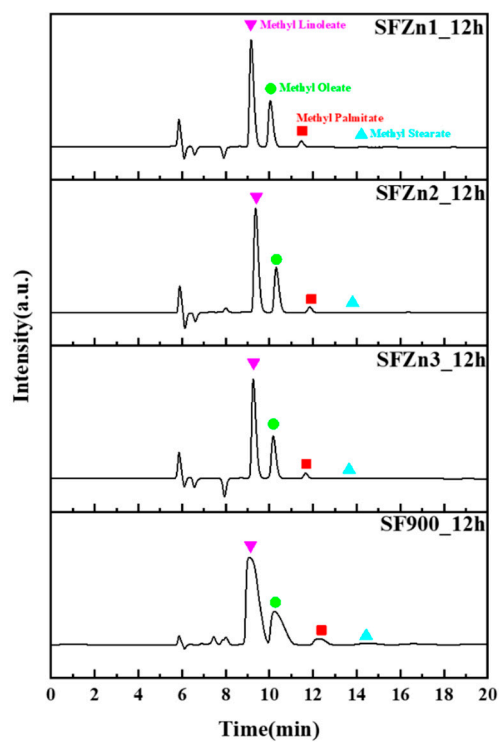
**Figure S6.** The XPS spectra of the SFZn1 (a) Ca 2p, (b) Mg 1s, (c) Zn 2p, (d) O 1s



**Figure S7.** The XPS spectra of the SFZn3 (a) Ca 2p, (b) Mg 1s, (c) Zn 2p, (d) O 1s



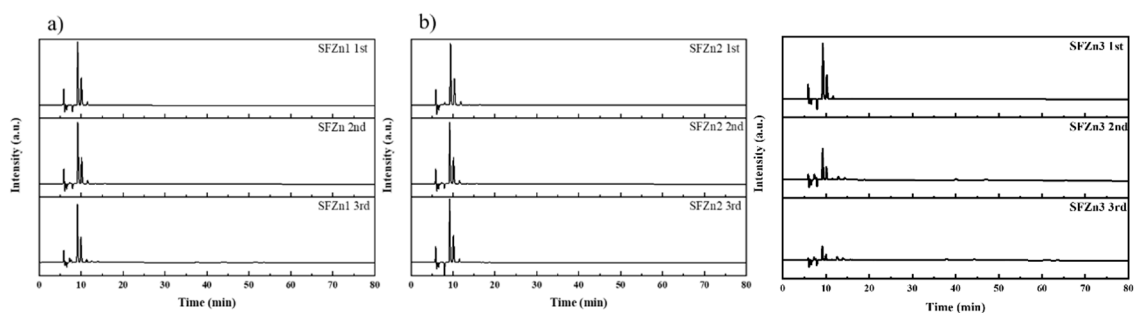
**Figure S8.** HPLC data for different transesterification time under 68 °C of SFZn2.



**Figure S9.** HPLC data for 12h transesterification under 68 °C. (SF900: Non-dilution, SFZnx: Dilution ratio 1:5 to mobile



phase)



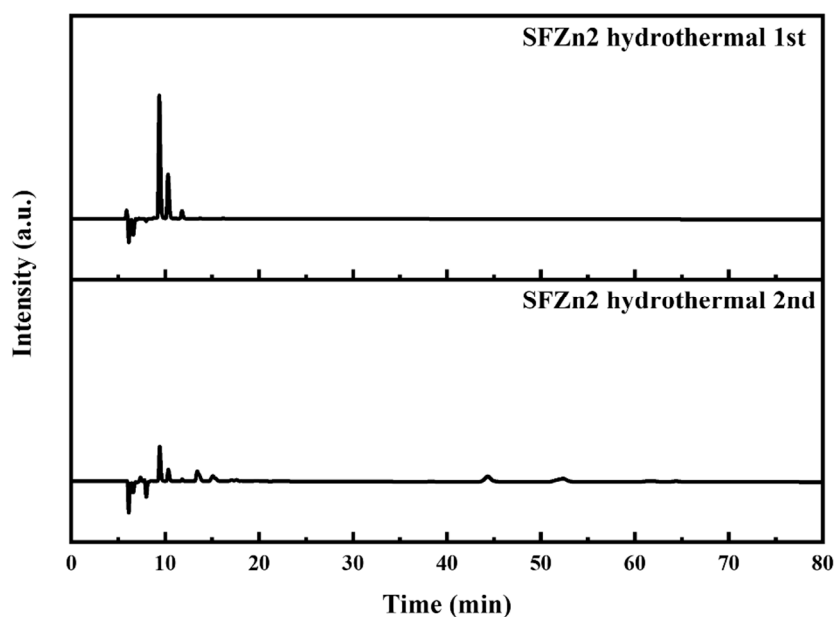
**Figure S10.** HPLC data for 3 times recycle of catalysts (12 h, 68 °C) (a) SFZn1, (b) SFZn2, (c) SFZn3.

**Table S1.** Biodiesel yield through transesterification with different transesterification time under 68 °C.

Catalyst	Yield				Total Yields (%)
	Methyl Linoleate (%)	Methyl Oleate (%)	Methyl Palmitate (%)	Methyl Stearate (%)	
4 h	6.3	3.6	0.7	2.6	13.2
6 h	51.4	12.5	5	2.7	71.6
8 h	69	15.5	5.6	3.7	93.8
10 h	70.1	15.6	6.3	3.8	95.8
12 h	71.4	15.3	7	4	97.7

### Synthesis Hydrothermal process catalysts

A molar ratio of 10:1 for SF900 and Zinc acetate dihydrate was placed in each beaker and stirred at 600 rpm with 100 deionized water for 2 h. After stirring, both solutions were added to a Teflon-lined autoclave with 0.1 M ammonia solution. Then, Hydrothermal treatment proceeded at 120 °C for 12 h, and filtration was followed. For the last step, drying at 105 °C oven for 3 h and calcined at 850 °C for 2 h [36,37].



**Figure S11.** HPLC data for 2 times recycling of a catalyst via hydrothermal treatment (68 °C for 12 h)

**Table S2.** Biodiesel yield via transesterification for 12 h under 68 °C with hydrothermal treated catalyst

Catalyst	Yield				Total Yields (%)
	Methyl Linoleate (%)	Methyl Oleate (%)	Methyl Palmitate (%)	Methyl Stearate (%)	
Hydrothermal 1 <sup>st</sup>	47.3	13.1	3.96	1.9	72.3
Hydrothermal 2 <sup>nd</sup>	15.4	12.8	3.42	1.8	33.4