

## **Supplementary material**

### **Highly Efficient Adsorption Characteristics and Mechanism of Nutshell**

### **Biochars for Aromatic Organophosphorus Insecticides**

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**Table S1 Reported materials for adsorption of organophosphorus pesticides.**

Pesticide	Adsorption material	Adsorption equilibrium time (min)	Removal rate of adsorption (%)	Reference
Profenofos	Fe/Ni bimetallic nanoparticles	16	96	[28]
Profenofos	magnetic multi-walled carbon nanotubes @ organic framework ZIF- 8	15	96	[49]
Glyphosate	rice husk biochar	90	76	[57]
Chlorpyrifos	rGO@ZnO composite	70	95	[58]
Chlorpyrifos	nanoscale Moringa olivera seeds waste	30	81	[59]
Acephate	microwave synthesized zeolitic material	90	53	[60]

**Table S2 Thermodynamic fitting parameters.**

Biochar	Parameters	T (K)		
		298	308	318
Coconut shell	$\ln K^0$	2.56	2.63	2.69
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	-6.34	-6.74	-7.11
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	4.89		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	37.7		
Almond shell	$\ln K^0$	1.71	1.88	2.04
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	-4.24	-4.81	-5.39
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	12.5		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	56.3		
Walnut shell	$\ln K^0$	1.14	1.24	1.35
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	-2.82	-3.18	-3.57
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	8.07		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	36.6		
Rice stalks	$\ln K^0$	-1.86	-1.44	-0.54
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	4.61	3.68	1.43
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	51.71		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	157.38		
Rice hulls	$\ln K^0$	-2.77	-2.32	-1.91
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	6.86	5.95	5.04
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	34.02		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	91.12		
Bamboo	$\ln K^0$	-2.98	-2.56	-2.21

Corn stalks	$\Delta G^0$ (kJ mol <sup>-1</sup> )	7.39	6.56	5.85
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	30.38		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	77.24		
	$\ln K^0$	-3.41	-2.88	-2.24
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	8.45	7.36	5.93
Wood	$\Delta H^0$ (kJ mol <sup>-1</sup> )	45.87		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	125.38		
	$\ln K^0$	-4.20	-3.51	-3.39
	$\Delta G^0$ (kJ mol <sup>-1</sup> )	10.40	8.99	8.96
	$\Delta H^0$ (kJ mol <sup>-1</sup> )	32.11		
	$\Delta S^0$ (J mol <sup>-1</sup> K <sup>-1</sup> )	73.58		

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Figure S1 N<sub>2</sub> adsorption and desorption isothermal curve.

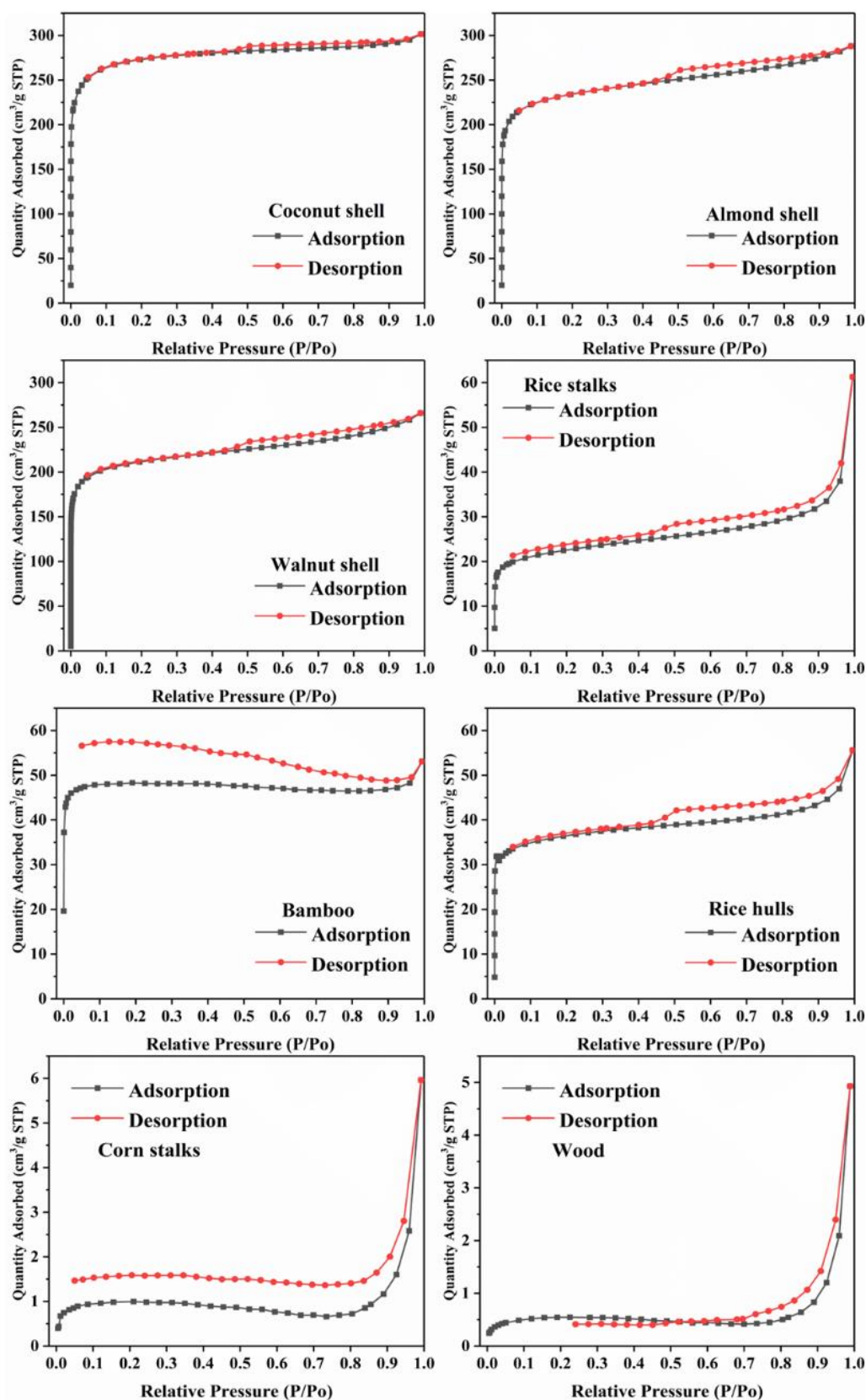
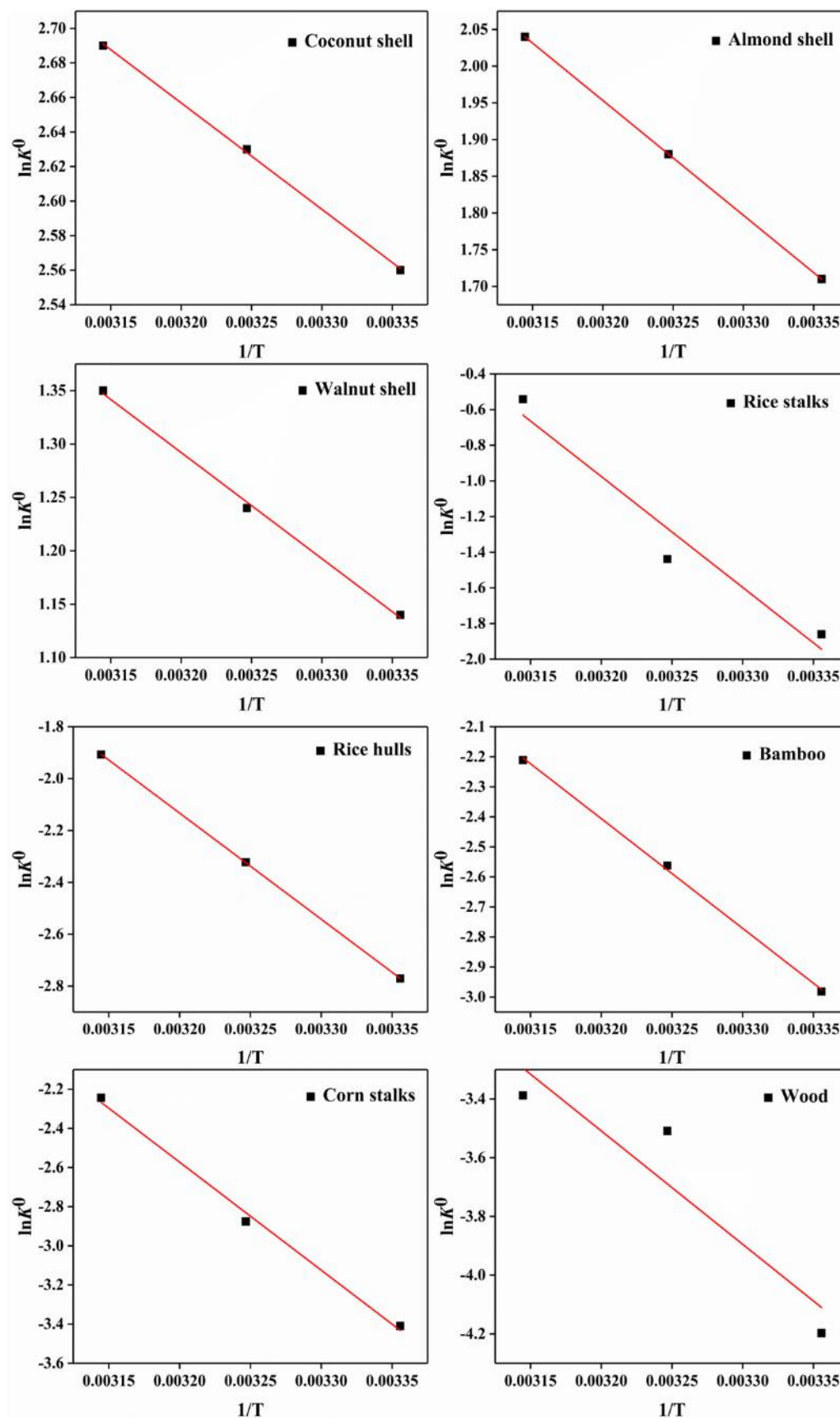
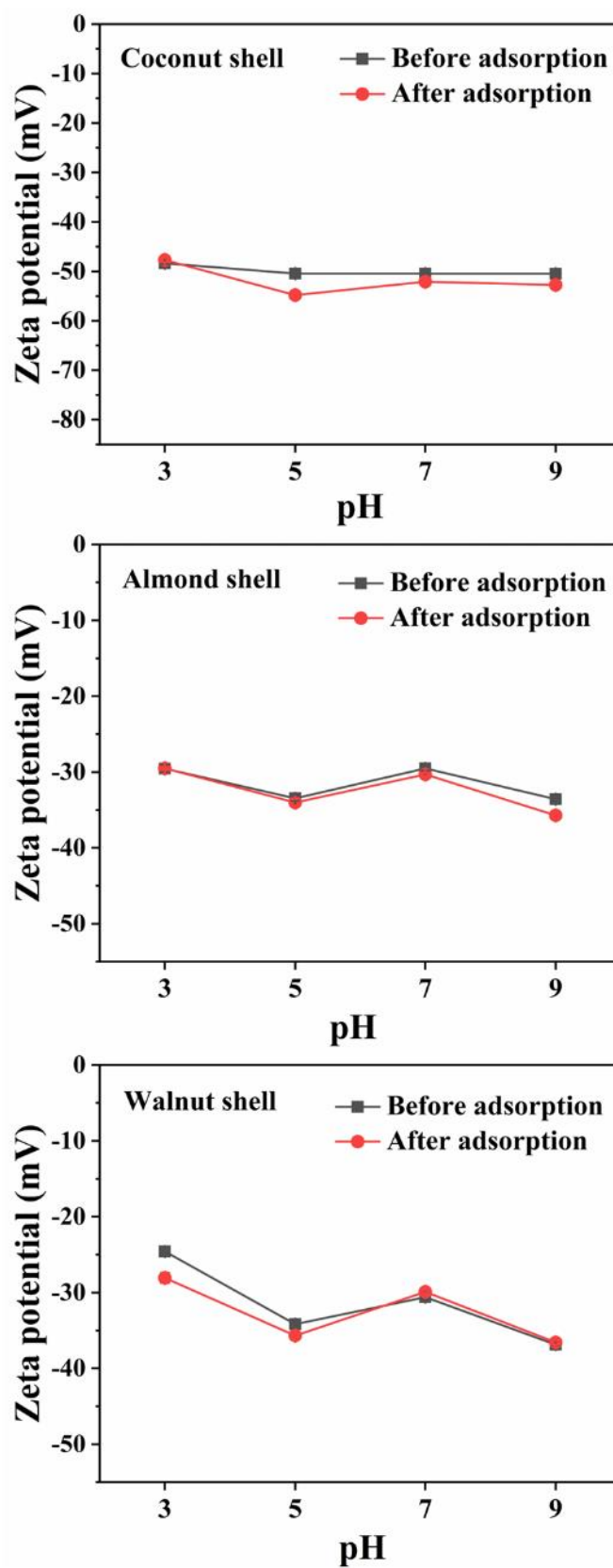


Figure S2 Thermodynamic fitting diagram.

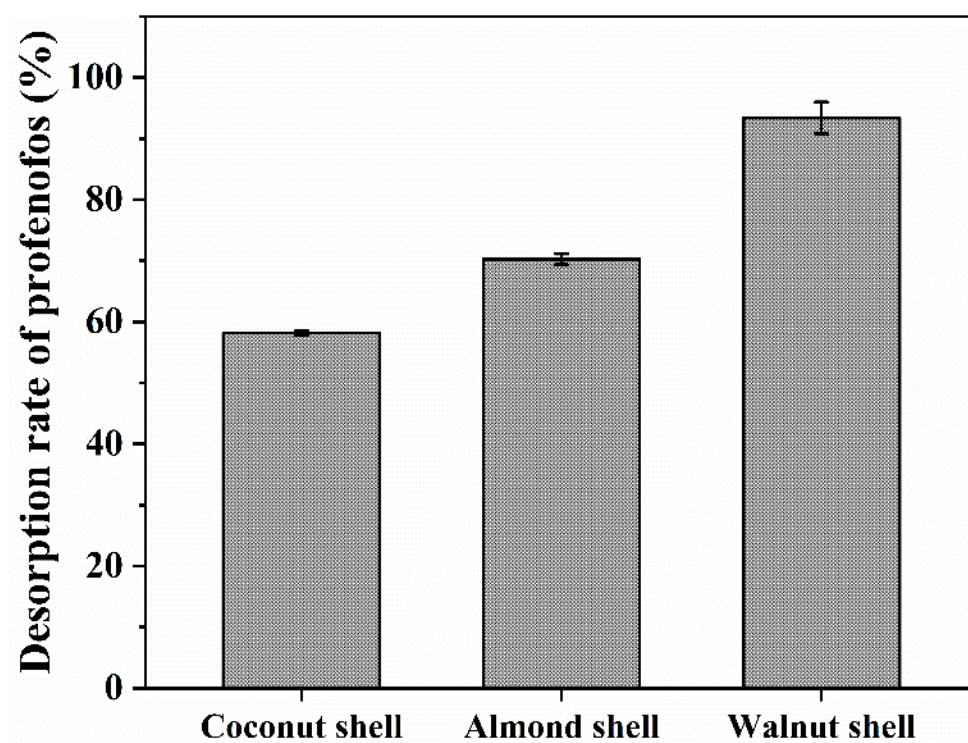


**Figure S3 Zeta potential of nutshell biochars before and after adsorption.**

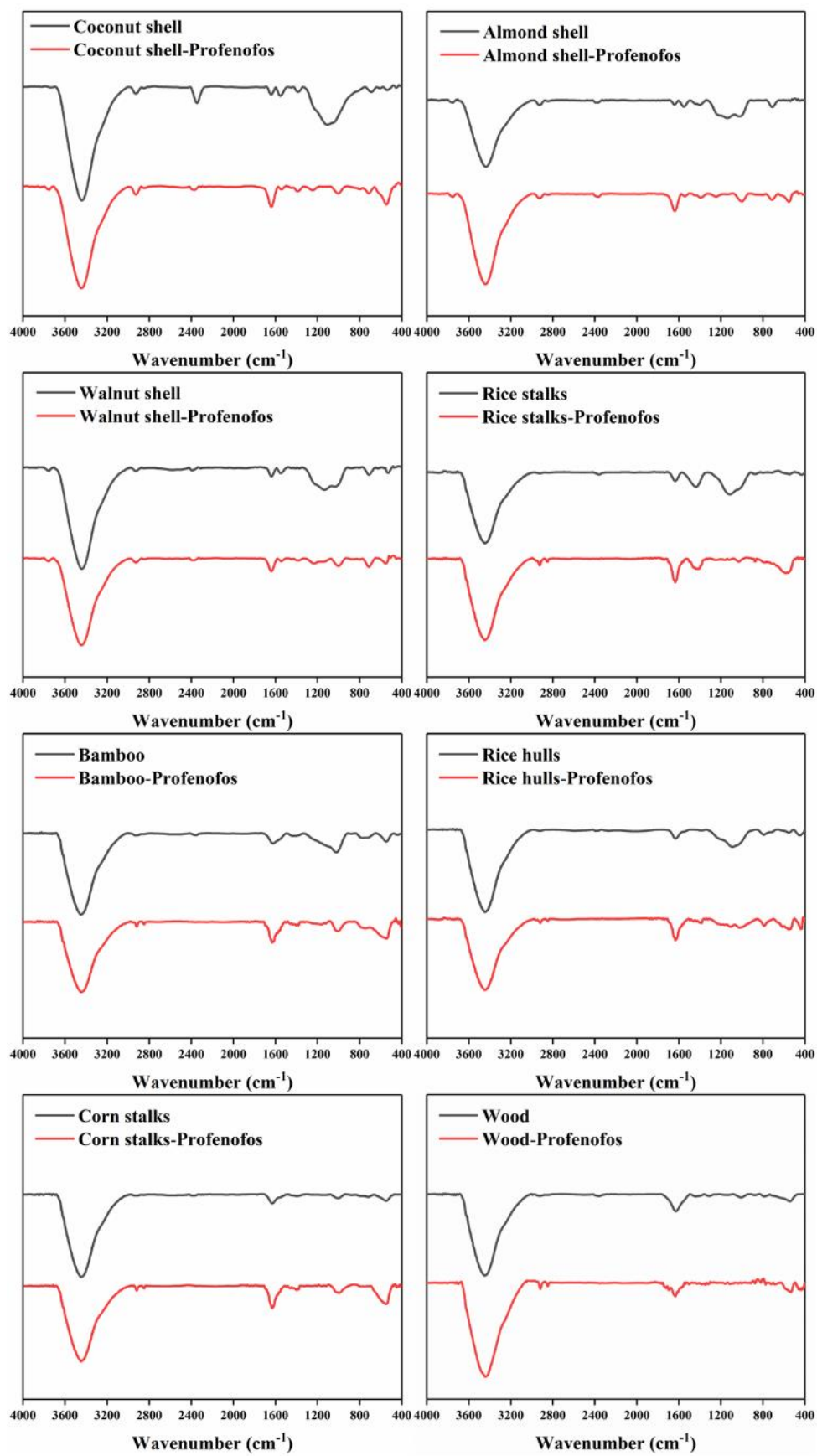




**Figure S4 Desorption of profenofos on nutshell biochars by acetonitrile.**



**Figure S5 FTIR of biochars before and after adsorption of profenofos.**



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