Supplementary Material

Table S1 Moisture content range of the textiles.

Types	Original moisture content (%)	Range of moisture content after adding water (%)
Cotton	0.51	21.18–61.02
Ramie	0.44	9.97–59.25
Wool	0.74	10.12–61.39
Silk	0.66	4.09–67.68
Viscose	1.35	15.25–53.78
PA	0.37	12.90–65.40
PET	0.08	10.87–54.34
PP	0.18	8.00–50.69
Acetate	0.35	16.08–50.66
Polyester cotton blend	0.40	22.43–50.40

Table S2 Hyperparameters of each algorithm.

Algorithm	Hyperparameters	Meaning of hyperparameters
RF	n_estimators	The number of decision trees
SVR	C	Penalty factor, it means the degree of tolerance for errors. The higher the value is, the more likely it is to overfit
	gamma	The coefficients of the kernel function
PLSR	n_components	Number of components to keep
XGBOOST	n_estimators	The number of decision trees
	subsample	The subsample ratio of the training instance, which is used to pretend overfitting.
KNN	n_neighbors	The number of neighbors(data) for training

Notes: the hyperparameters that have significant impact on the prediction performance of the models were chosen and listed.

Table S3 Hyperparameters of the models predicting the elemental compositions of solid wastes using full spectra and spectra with feature.

Models		Hyperparameters	Optimal values											
Feature selection	Algorithm		C_1	C_2	C_3	H_1	H_2	H_3	N_1	N_2	N_3	S_1	S_2	S_3
None	RF	n_estimators	15	29	17	11	27	24	88	13	5	48	57	78
	SVR	C	365.52	10000.00	246.94	926.53	981.63	77.78	467.34	23.22	97.98	12.25	19.14	67.67
		gamma	0.009	0.006	0.008	0.008	0.003	0.005	0.013	0.007	0.010	0.015	0.010	0.010
	PLSR	n_components	48	21	39	54	17	24	47	47	43	29	28	39
	XGBOOST	n_estimators	23	49	56	66	62	10	29	67	8	67	13	13
		subsample	1	0.54	0.60	0.85	0.74	0.78	0.49	0.93	0.67	0.91	0.72	0.98
	KNN	n_neighbors	2	1	1	1	2	2	2	3	3	5	8	1
SPA	RF	n_estimators	21	12	32	18	25	28	1	1	40	15	21	2
	SVR	C	1000.00	610.20	1489.20	302.04	93.88	83.84	1734.69	1000.00	1857.43	8.17	97.96	23.22
		gamma	0.212	0.131	0.232	0.164	0.131	0.151	0.45	0.293	0.232	0.616	0.540	1.59
	PLSR	n_components	23	17	20	23	21	18	24	16	21	18	20	22
	XGBOOST	n_estimators	95	81	78	149	28	48	87	110	78	110	115.	48
		subsample	0.91	0.38	0.49	0.43	0.52	0.60	0.39	0.49	0.76	0.76	0.28	0.34
	KNN	n_neighbors	1	1	3	1	1	2	1	1	1	5	1	6
CARS	RF	n_estimators	15	36	21	92	38	34	78	6	57	147	83	10
	SVR	C	595.92	265.31	559.18	136.73	5.244	412.24	338.77	228.57	73.73	4.09	265.31	29.29
		gamma	0.151	0.131	0.131	0.062	0.050	0.003	0.245	0.434	0.353	0.169	0.212	0.678
	PLSR	n_components	31	29	16	35	25	24	37	33	18	28	28	13
	XGBOOST	n_estimators	198	70	76	21	59	66	108	44	117	53	55	55
		subsample	0.94	0.41	0.72	0.98	0.80	0.71	0.34	0.67	0.71	0.61	0.34	0.34
	KNN	n_neighbors	1	1	1	1	1	1	1	1	2	5	1	6

Table S4 Hyperparameters of the models predicting the elemental compositions of solid wastes under noise interference.

Noise factor	Model algorithm	Hyperparameters	Optimal values											
			C_1	C_2	C_3	H_1	H_2	H_3	N_1	N_2	N_3	S_1	S_2	S_3
0.0	RF	n_estimators	15	29	17	11	27	24	88	13	5	48	57	78
	SVR	C	365.52	10000.00	246.94	926.53	981.63	77.78	467.34	23.22	97.98	12.25	19.14	67.67
		gamma	0.009	0.006	0.008	0.008	0.003	0.005	0.013	0.007	0.010	0.015	0.010	0.010
	PLSR	n_components	48	21	39	54	17	24	47	47	43	29	28	39
	XGBOOST	n_estimators	23	49	56	66	62	10	29	67	8	67	13	13
		subsample	1	0.54	0.60	0.85	0.74	0.78	0.49	0.93	0.67	0.91	0.72	0.98
	KNN	n_neighbors	2	1	1	1	2	2	2	3	3	5	8	1
0.1	RF	n_estimators	57	55	36	19	24	13	24	5	45	19	21	20
	SVR	C	485.71	2224.49	91.92	283.67	100	522.45	210.20	1183.67	17.16	3.02	5.041	4.90
		gamma	0.009	0.005	0.009	0.004	0.004	0.005	0.013	0.005	0.009	0.014	0.007	0.008
	PLSR	n_components	22	29	25	22	15	22	26	24	13	19	22	22
	XGBOOST	n_estimators	72	27	60	58	60	77	74	76	52	37	19	12
		subsample	1.0	0.74	0.38	0.92	0.82	0.92	0.67	0.71	0.43	0.94	0.74	0.87
	KNN	n_neighbors	2	1	1	1	3	2	2	1	1	5	5	6
0.2	RF	n_estimators	112	14	20	14	4	30	65	85	16	48	85	22
	SVR	C	173.47	446.94	926.53	155.10	29.29	173.47	136.73	155.10	191.84	3.02	31.31	5.04
		gamma	0.008	0.007	0.003	0.004	0.002	0.004	0.013	0.010	0.008	0.012	0.006	0.008
	PLSR	n_components	16	15	13	21	13	18	18	18	16	19	13	23
	XGBOOST	n_estimators	54	42	29	20	60	70	29	67	78	49	53	58
		subsample	1.000	0.906	0.743	0.908	0.596	0.724	0.633	1.000	0.871	0.798	0.927	0.945
	KNN	n_neighbors	2	1	3	1	4	1	2	1	2	5	1	2
0.5	RF	n_estimators	12	25	33	15	44	16	13	54	22	30	34	11
	SVR	C	191.83	173.46	246.93	41.40	71.71	11.10	71.71	77.77	17.16	1.51	1.67	9.08
		gamma	0.0037	0.004	0.003	0.003	0.002	0.002	0.006	0.006	0.006	0.005	0.003	0.005
	PLSR	n_components	14	12	13	13	14	11	8	14	13	13	11	15

	XGBOOST	n_estimators	30	58	77	17	64	31	69	9	9	25	17	17
		subsample	0.88	0.70	0.65	1.00	0.57	0.69	0.37	0.85	0.88	1.00	0.57	0.59
	KNN	n_neighbors	2	1	2	2	3	3	2	1	1	5	8	1
0.8	RF	n_estimators	24	13	35	54	32	18	14	69	40	47	66	60
	SVR	C	136.73	130.61	87.88	25.24	11.10	29.29	57.57	16.33	21.20	1.41	3.20	3.02
		gamma	0.003	0.002	0.002	0.003	0.002	0.002	0.004	0.004	0.004	0.003	0.003	0.004
	PLSR	n_components	8	9	10	8	5	12	8	5	13	12	10	11
	XGBOOST	n_estimators	33	99	31	59	26	25	7	4	9	54	21	18
		subsample	0.98	0.76	0.56	1.00	0.71	0.82	0.93	0.47	0.65	0.74	0.98	0.69
	KNN	n_neighbors	2	6	5	2	11	1	1	1	2	3	6	4
1.0	RF	n_estimators	42	33	50	24	20	35	55	40	68	45	29	23
	SVR	C	93.94	116.33	136.73	23.22	7.06	23.22	49.49	13.12	19.18	1.18	15.14	1.22
		gamma	0.003	0.002	0.002	0.002	0.001	0.002	0.003	0.003	0.003	0.002	0.001	0.002
	PLSR	n_components	8	9	9	11	3	7	8	7	7	7	10	9
	XGBOOST	n_estimators	19	35	55	23	11	52	12	8	15	59	42	12
		subsample	1.00	0.87	0.74	0.58	0.76	1.00	0.60	0.69	1.00	0.93	0.60	0.76
	KNN	n_neighbors	3	5	3	2	1	5	1	2	2	5	2	1

Table S5 Hyperparameters of the models predicting the elemental compositions of solid wastes using full spectra and spectra with feature selection under moisture interference.

Models		Hyperparameters	Optimal values											
Feature selection	Algorithm		C_1	C_2	C_3	H_1	H_2	H_3	N_1	N_2	N_3	S_1	S_2	S_3
None	RF	n_estimators	25	9	71	4	108	39	15	3	83	77	6	11
	SVR	C	155.10	21.20	302.04	63.27	37.37	7.06	191.84	51.51	27.27	6.13	2.86	4.08
		gamma	0.002	0.002	0.001	0.001	0.002	0.001	0.002	0.002	0.003	0.004	0.007	0.030
	PLSR	n_components	28	19	16	22	25	27	26	21	21	11	37	37
	XGBOOST	n_estimators	25	18	29	45	54	14	36	9	9	113	5	4
		subsample	0.30	0.94	0.43	0.96	0.60	0.98	0.96	0.67	0.83	0.65	0.78	1.00
	KNN	n_neighbors	7	2	2	6	4	4	1	2	1	2	4	4
SPA	RF	n_estimators	16	49	119	32	6	21	30	16	40	3	56	22
	SVR	C	357.14	29.29	63.63	55.11	5.04	53.53	69.39	11.10	63.63	25.27	85.86	47.47
		gamma	0.050	0.071	0.050	0.131	0.091	0.111	0.172	0.210	0.155	0.449	0.247	0.394
	PLSR	n_components	17	21	18	21	22	17	21	17	16	10	10	11
	XGBOOST	n_estimators	17	44	19	20	11	19	108	22	46	11	5	13
		subsample	0.743	0.927	0.945	0.982	0.908	0.596	0.479	0.908	0.963	0.982	0.504	0.780
	KNN	n_neighbors	4	6	2	12	3	2	1	1	1	5	1	1
CARS	RF	n_estimators	5	48	10	46	34	26	81	2	14	5	11	6
	SVR	C	87.76	448.98	69.69	40.82	17.16	13.12	265.31	63.63	49.49	118.3	15.14	25.24
		gamma	0.030	0.010	0.019	0.030	0.043	0.036	0.050	0.021	0.038	0.111	0.137	0.339
	PLSR	n_components	25	22	14	24	33	27	26	16	15	11	16	34
	XGBOOST	n_estimators	20	41	14	51	23	32	17	97	69	16	45	20
		subsample	0.50	0.96	0.80	0.45	0.85	0.87	0.91	0.39	0.76	0.69	0.34	0.87
	KNN	n_neighbors	5	2	3	8	2	3	2	3	1	3	2	4

Table S6 Elemental compositions of the samples.

Species	Element	Range (%)	Mean (%)	Standard deviation (%)
Leather	C	34.52–57.07	41.45	5.47
	H	3.78–7.03	5.57	0.77
	N	0.59–13.13	7.97	3.97
	S	0.12–2.62	1.09	0.67
Paper	C	29.63–41.81	35.54	2.79
	H	3.97–6.74	5.30	0.56
	N	0.02–0.33	0.18	0.09
	S	0.03–0.24	0.11	0.04
Wood	C	38.33–43.35	41.56	1.36
	H	5.19–6.11	5.78	0.26
	N	0.05–0.19	0.09	0.05
	S	0.04–0.45	0.14	0.13
Textile	C	40.31–65.53	50.72	8.86
	H	4.41–9.65	6.47	1.32
	N	0.02–23.90	6.80	8.88
	S	0.01–2.89	0.35	0.86
Plastic	C	37.78–92.28	75.74	12.21
	H	4.23–14.78	11.05	3.90
	N	0–6.15	0.70	1.64
	S	0–1.18	0.20	0.29

Table S7 Feature spectra selected by SPA and CARS.

Element	Feature selection methods	
	SPA (cm^{-1})	CARS (cm^{-1})
C	694, 766, 800, 836, 870, 906, 992, 1016, 1056, 1262, 1280, 1376, 1394, 1424, 1524, 1540, 1556, 1572, 1732, 1754, 1770, 2030, 2572, 2836, 2848, 2894, 2932, 2952, 2988, 3298, 3690	652, 654, 656, 692, 694, 856, 866, 882, 908, 910, 992, 1014, 1128, 1130, 1178, 1182, 1184, 1284, 1286, 1316, 1318, 1320, 1358, 1360, 1362, 1534, 1646, 1678, 1754, 1768, 1786, 1968, 2640, 2642, 2644, 2646, 2648, 2650, 2652, 2666, 2822, 2828, 2846, 2848, 2858, 2884, 2886, 2888, 2986, 2988, 2990, 2992, 3022, 3024, 3026, 3028, 3030, 3032, 3122, 3134, 3136, 3294, 3566, 3568, 3570, 3576
H	700, 800, 832, 870, 908, 958, 1010, 1020, 1102, 1212, 1280, 1334, 1424, 1452, 1502, 1572, 1636, 1668, 1692, 1732, 1772, 2598, 2836, 2848, 2894, 2932, 2952, 2988, 3298, 3374, 3538	714, 716, 718, 734, 736, 738, 740, 764, 766, 768, 788, 790, 792, 794, 814, 816, 818, 850, 852, 854, 856, 858, 860, 866, 868, 870, 872, 878, 880, 882, 884, 942, 944, 946, 948, 950, 952, 954, 956, 958, 960, 962, 964, 966, 978, 980, 982, 984, 986, 988, 990, 992, 994, 996, 998, 1010, 1012, 1042, 1044, 1046, 1228, 1230, 1232, 1234, 1236, 1238, 1286, 1288, 1290, 1292, 1294, 1296, 1332, 1334, 1372, 1374, 1376, 1390, 1392, 1394, 1396, 1702, 1726, 1728, 1730, 1738, 1766, 1768, 1770, 1824, 2240, 2242, 2244, 2246, 2248, 2624, 2628, 2630, 2632, 2634, 2816, 2818, 2820, 2822, 2824, 2826, 2828, 2830, 2832, 2834, 2836, 2846, 2848, 2850, 2852, 2854, 2856, 2858, 2912, 2914, 2916, 2918, 2986, 2988, 3292, 3294, 3296, 3298, 3300, 3302, 3304, 3330, 3332, 3334, 3336, 3338, 3340, 3342, 3344, 3566
N	700, 724, 870, 890, 956, 1058, 1100, 1262, 1280, 1334, 1360, 1404, 1458, 1580, 1618, 1638, 1692, 1772, 1828, 2160, 2598, 2834, 2848, 2916, 2952, 2980, 3298, 3396, 3690	696, 734, 790, 852, 854, 882, 944, 946, 1046, 1048, 1180, 1278, 1280, 1316, 1318, 1320, 1362, 1364, 1406, 1408, 1410, 1444, 1446, 1448, 1450, 1472, 1524, 1526, 1614, 1616, 1634, 1684, 1844, 1996, 1998, 2000, 2014, 2016, 2020, 2044, 2046, 2236, 2238, 2240, 2242, 2244, 2246, 2828, 2830, 2948, 3300, 3366, 3748, 3750
S	800, 870, 1060, 1098, 1216, 1260, 1280, 1334, 1362, 1424, 1454, 1524, 1544, 1620, 1638, 1686, 1712, 1732, 1756, 1772, 2160, 2628, 2838, 2914, 2932	716, 744, 746, 838, 840, 854, 856, 858, 860, 862, 1060, 1062, 1090, 1092, 1144, 1200, 1202, 1204, 1264, 1274, 1314, 1316, 1318, 1352, 1354, 1356, 1416, 1602, 1724, 1726, 1756, 1832, 1972, 2158, 2160, 2232, 2330,

2350, 2352, 2354, 2708, 2712, 2714, 2716,
2912, 2934, 2936, 2938, 3008, 3010, 3012,
3014, 3018, 3750

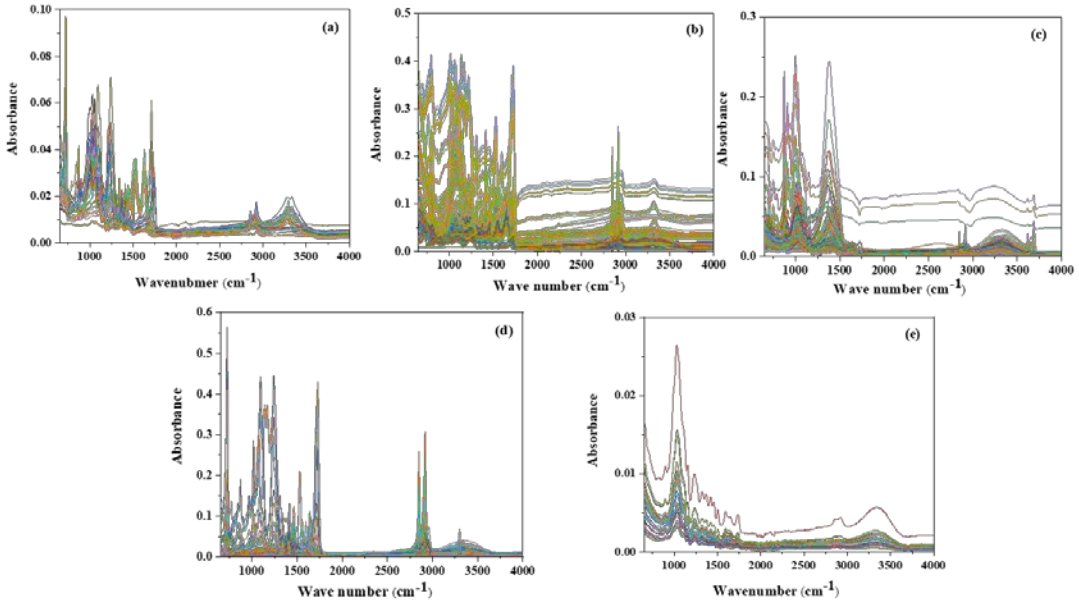

Fig. S1 FTIR spectra of the textile (a), leather (b), paper (c), plastic (d) and wood (e).

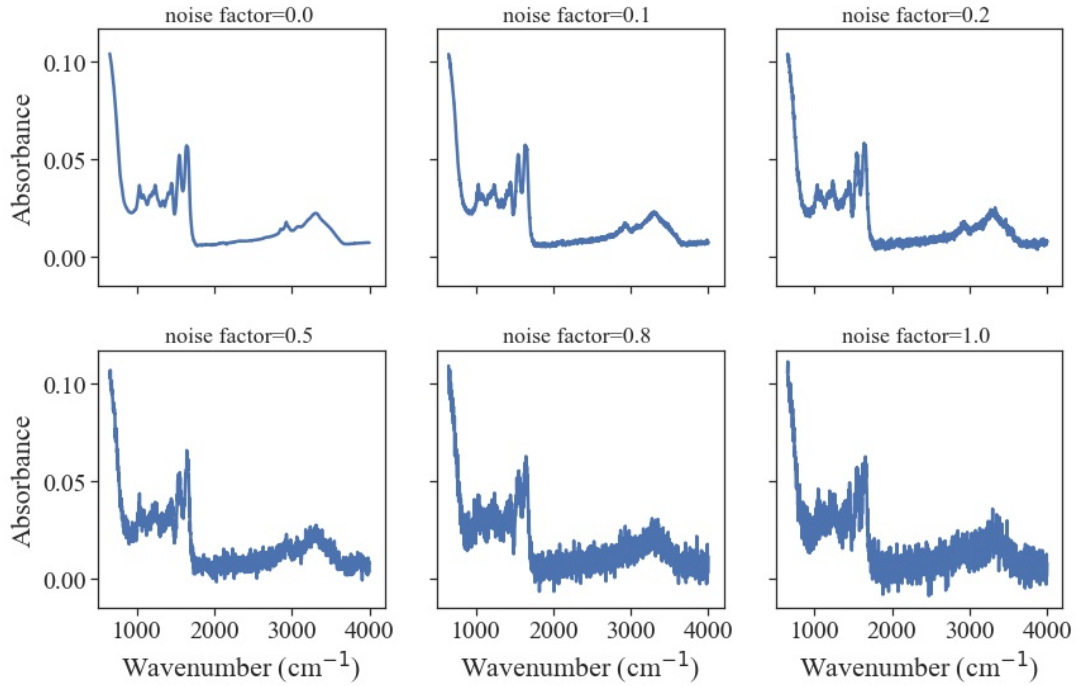

Fig. S2 Spectra of the cow leather with different noise factors.

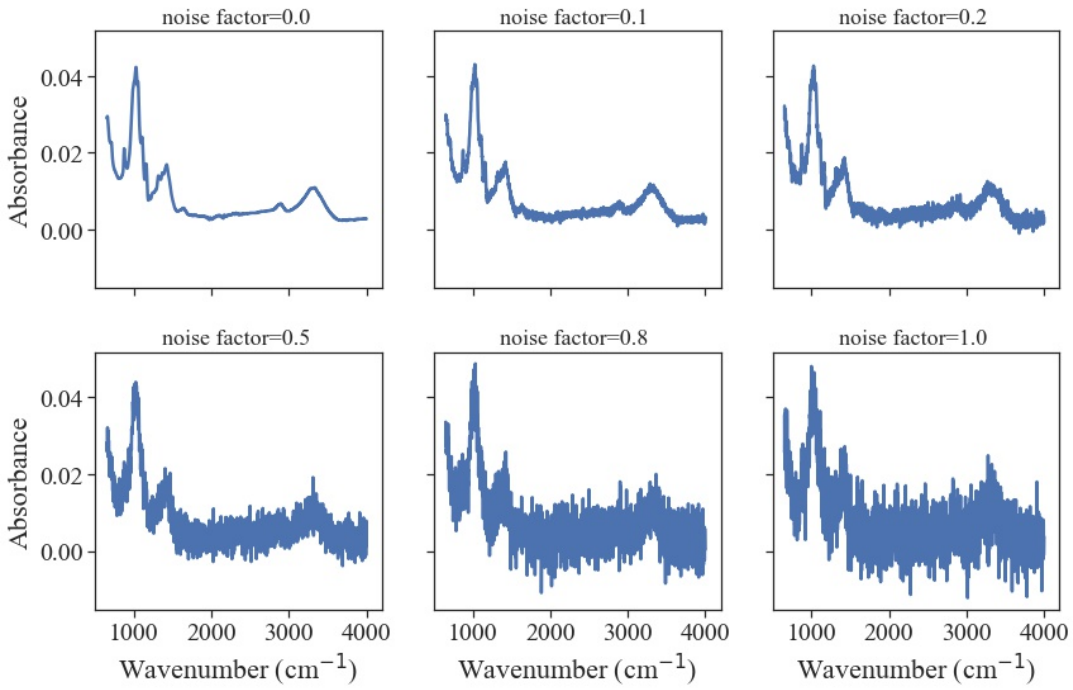

Fig. S3 Spectra of the office paper with different noise factors.

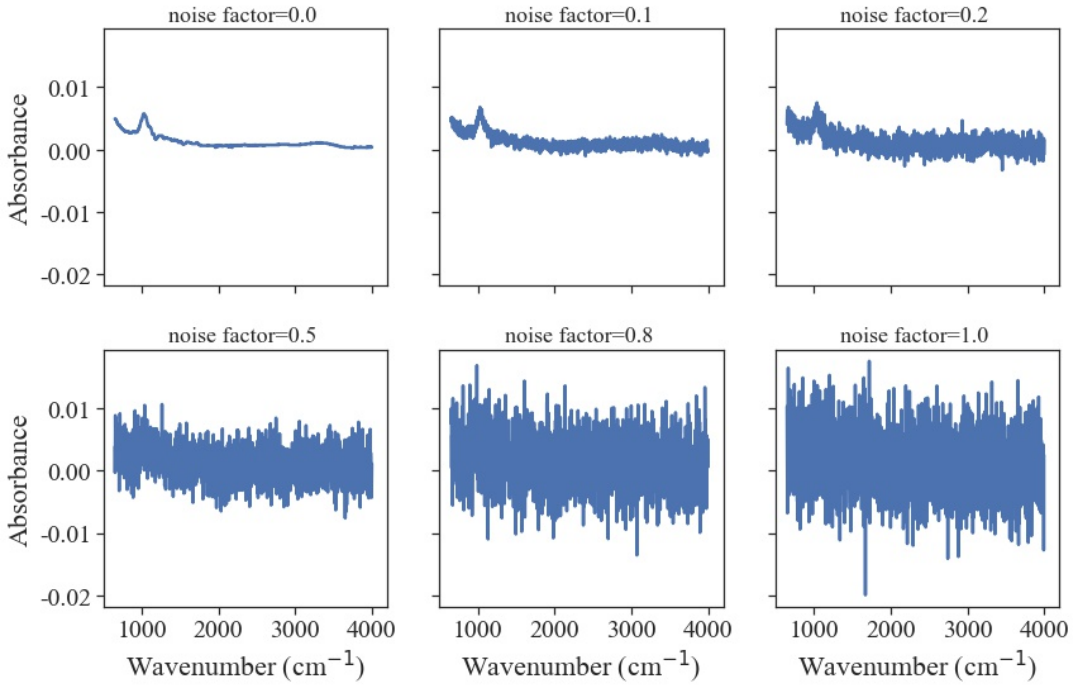

Fig. S4 Spectra of the beech with different noise factors.

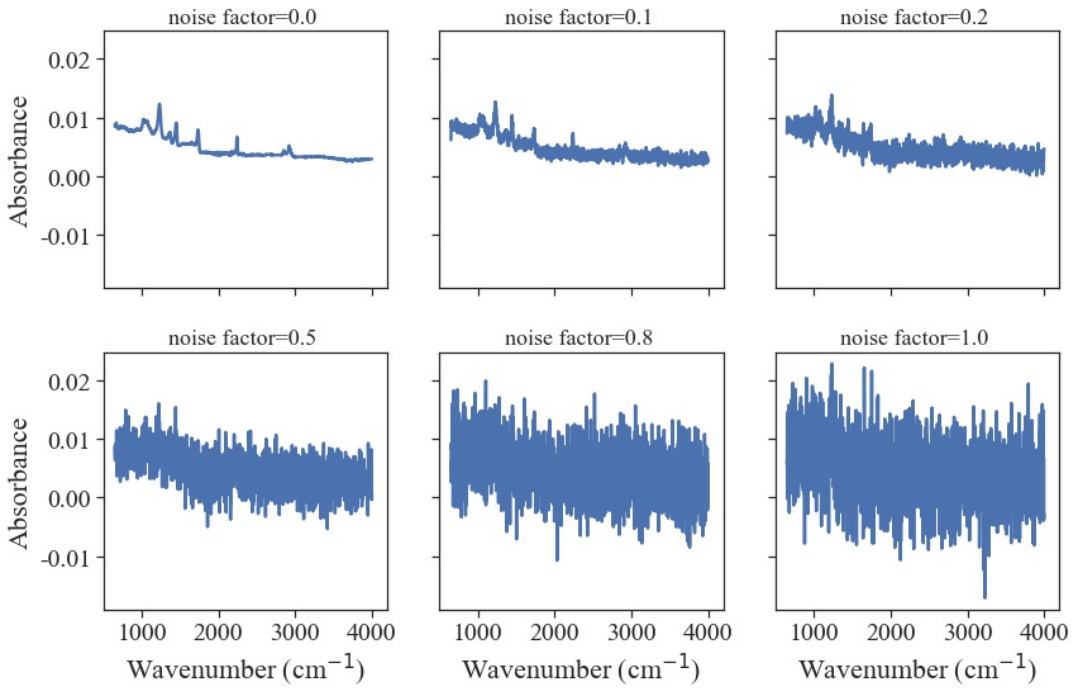

Fig. S5 Spectra of the PP textile with different noise factors.

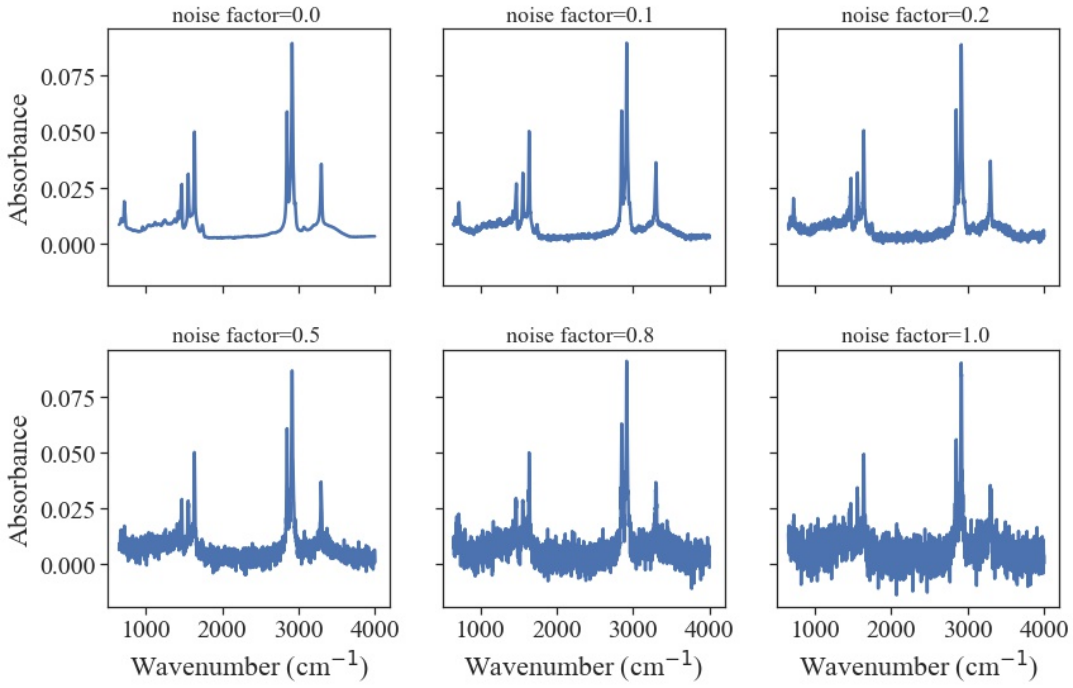

Fig. S6 Spectra of the LDPE resin with different noise factors.