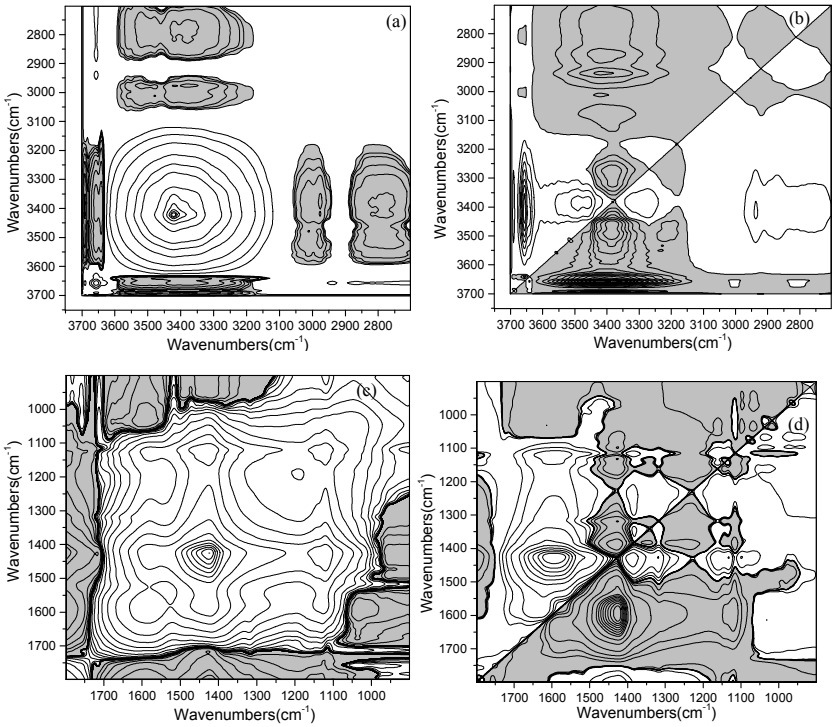

Figure 1 2D-PCIS spectra in the range of wavenumbers of 3750-2700 cm^{-1} and 1800-900 cm^{-1} analysis windows for chars (a, c) synchronous spectra and (b, d) asynchronous spectra. Light gray and white areas indicate negative and positive correlation values, respectively

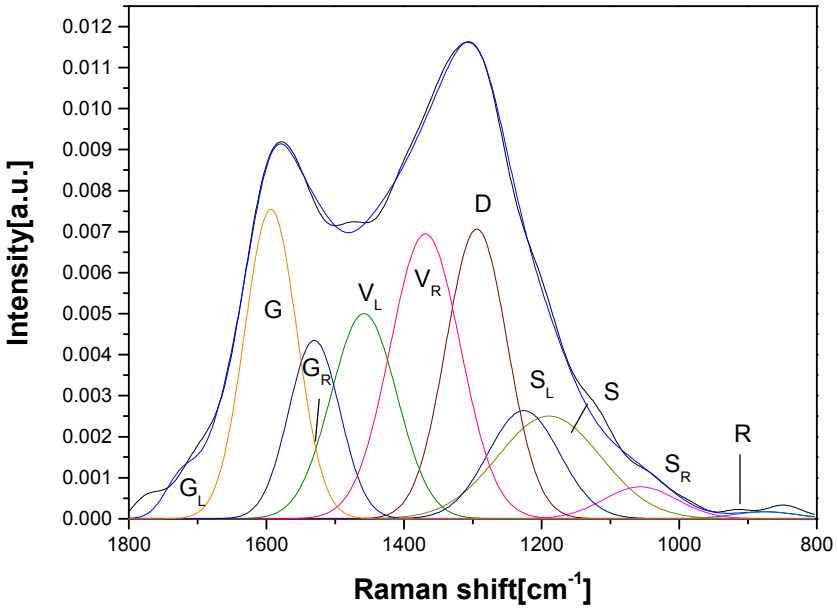

Figure 2Typical example to curve-fitting of a Raman spectrum of char obtained at 650 ℃

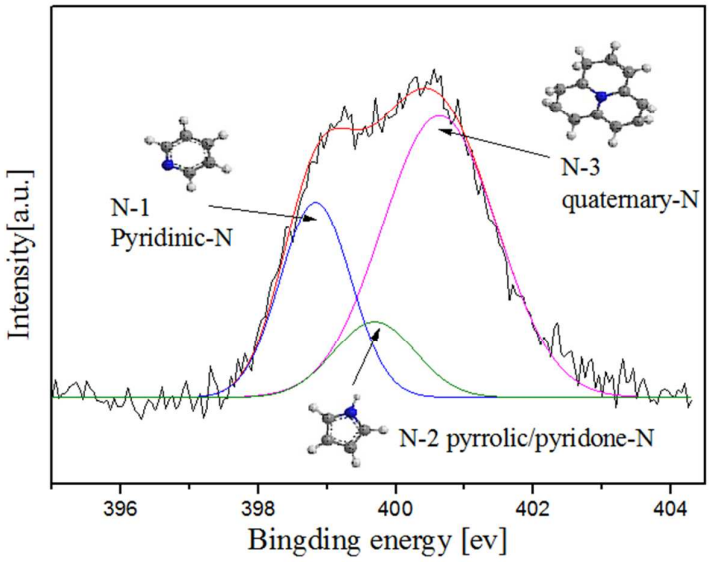

Figure 3 The typical example to curve-fitting of a XPS spectrum of char obtained at 550 °C

Table 1 Summary of Raman Peak/Band Assignment Representing the Typical Structures

Band name	Band position(cm^{-1})	Description	Bond type
G_l	1700	carbonyl group C=O	sp^2
G	1590	Graphite E^2_{2g};aromatic ring quadrant breathing; alkene C=C	sp^2
G_r	1540	Aromatics with 3-5 rings; amorphous carbon structures	sp^2
V_l	1465	methylene or methyl; semicircle breathing of aromatic rings; amorphous carbon structures	sp^2, sp^3
V_r	1380	Methyl group; semicircle breathing of aromatic rings; amorphous carbon structures	sp^2, sp^3
D	1300	D band on highly ordered carbonaceous materials; C-C between aromatic rings and aromatics with not less than 6 rings	sp^2
S_l	1230	aryl-alkyl ether; para-aromatics	sp^2, sp^3
S	1185	$C_{aromatic}$-C_{alkyl}; aromatic (aliphatic) ethers; C-C on hydro-aromatic rings; hexagonal diamond carbon sp^3; C-H on aromatic rings	sp^2, sp^3
S_r	1060	C-H on aromatic rings; benzene (ortho-disubstituted) rings	sp^2
R	960-800	C-C on alkanes and cyclic alkanes; C-H on aromatic rings	sp^2, sp^3