

Supplementary Documents

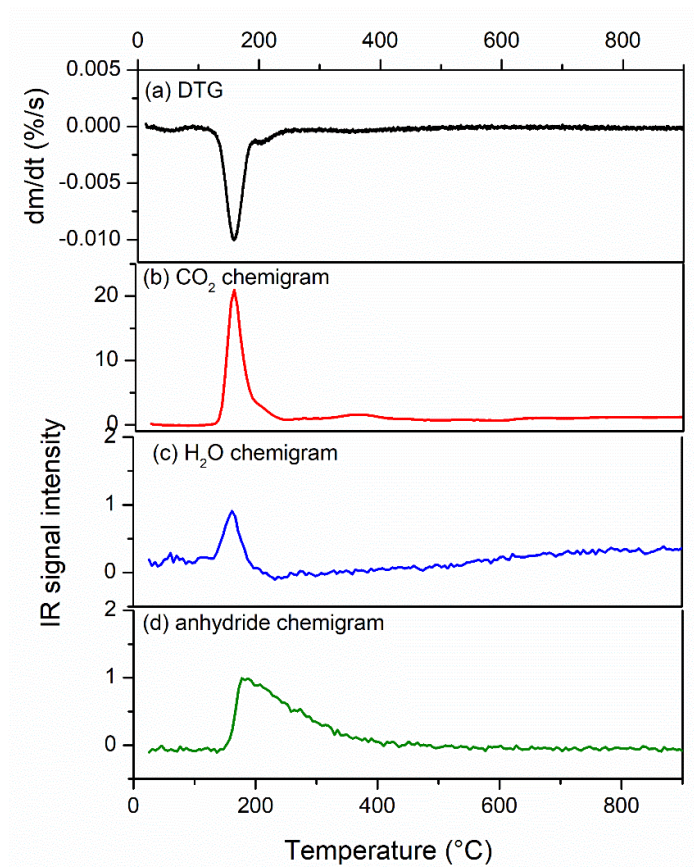


Figure S1. TGA-FTIR results of the A-C sample (i.e. Al_2O_3 +citric acid) at a heating rate of 5 °C/min under a N_2 flow: (a) DTG curve, (b) CO_2 evolution profile, (c) H_2O evolution profile, (d) anhydride evolution profile

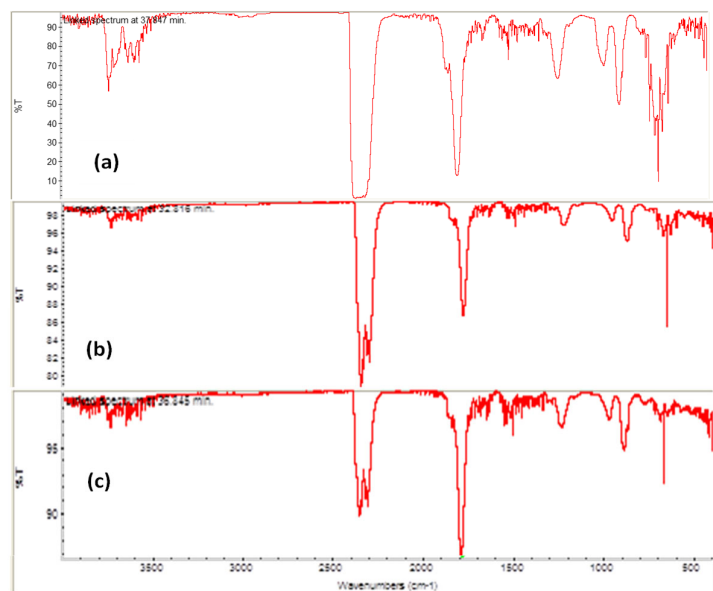


Figure S2. IR transmittance spectra of volatile products in the TGA-FTIR experiments (a heat ramp of 5 °C/min under N₂ flow): (a) pure citric acid at 213°C, (b) Al₂O₃ +citric acid at 188°C, (c) NiO/Al₂O₃ +citric acid at 208°C.

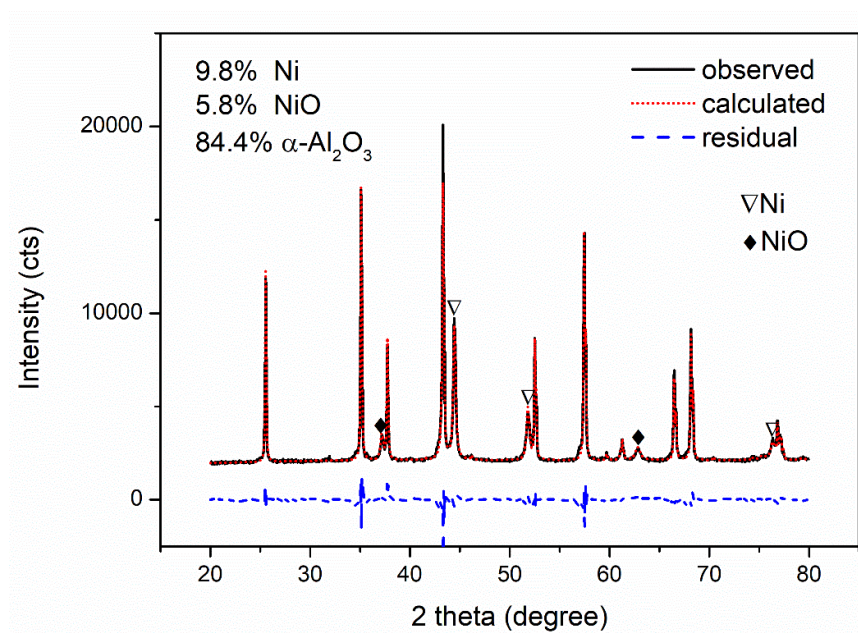


Figure S3. XRD profile of the NA-C-740 sample and its Rietveld refinement result: 84.4% α -Al₂O₃, 9.8% Ni and 5.8% NiO, weighted R profile is 4.10 and goodness of fitting is 4.34. (ICDD reference code for α -Al₂O₃: 04-005-4505, for NiO: 04-013-0890, for Ni: 04-010-6148)

Table S1. Wavenumber ranges set for collecting chemigrams of volatile products in the TGA-FTIR experiments

| component | Region(cm^{-1}) | Baseline(cm^{-1}) |
|----------------------|----------------------------|------------------------------|
| CO_2 | 2250-2400 | 2250-2400 |
| CO | 2000-2200 | 2000-2200 |
| H_2O | 1300-1600 | 1300-1600 |
| anhydride | 800-1100 | 800-1100 |

Table S2. IR bands in the above FTIR spectra and their assignment

| IR band wavenumber (cm^{-1}) | assignment |
|---|--|
| 4000-3400 | H_2O |
| 2250-2400 | CO_2 |
| 1700-1900 | C=O stretching vibration of anhydrides |
| 1600-1300 | H_2O |
| 1250 | C-O stretching vibration of anhydrides |
| 900, 970 | =CH & =CH ₂ bending vibration of anhydrides |
| 600-750 | CO_2 |