

Characterization of carbon dots by evolved gas analysis and Double-Shot analysis

[Background] Carbon dots, a kind of carbon-based zero-dimensional material with a size of < 10 nm, have many advantages such as excellent optical properties, environmental friendliness and good biocompatibility. Carbon dots are widely used in medical imaging technology, environmental monitoring, chemical analysis, catalyst preparation and energy development, etc. The property, however, is largely influenced by the structural composition. In this note, a carbon dots sample is characterized by evolved gas analysis (EGA) and double-shot Py-GC/MS.

[Experimental] A GC/MS system with a Multi-Shot Pyrolyzer (EGA/PY-3030D) directly interfaced to the injector of the GC/MS was used for measurements. When in EGA, a short and deactivated EGA tube (UADTM-2.5N) connected the GC injector and a mass spectrometer (detector). The pyrolyzer furnace temperature was programmed from 70 to 800 °C (20 °C/min). The GC oven temperature was isothermal at 300 °C. When in double-shot Py-GC/MS, first, a carbon dots sample was heated at 350 °C, then pyrolyzed at 500 °C. DB-17 capillary column was used as a separation column, and the GC oven temperature was programmed from 50 to 300 °C (10 min hold) at a ramp rate of 10 °C/min. The column flow rate was 1.0 mL/min (He). The MS scan range was m/z 40 - 600.

[Results] Total ion thermogram of the carbon dots sample obtained by EGA is shown in Fig.1, which shows two gas releasing processes: 1st from 100 to 350 °C and 2nd from 350 to 500 °C. The TIT shows that the decomposition temperature of the carbon dots sample is about 450 °C. Based on the result, the sample was first heated at 350 °C for thermal desorption and then pyrolyzed at 500 °C in double-shot Py-GC/MS. From the total ion current chromatograms (TICCs) in Fig.2, it was found that nonanoic acid was the main component during the 1st thermal desorption process, while the typical pyrolyzates of carbon dots including 2-decanone, 9-octadecyne, 9-hepta-decanone and 2-propylcyclohexanone were observed during the 2nd pyrolysis process.

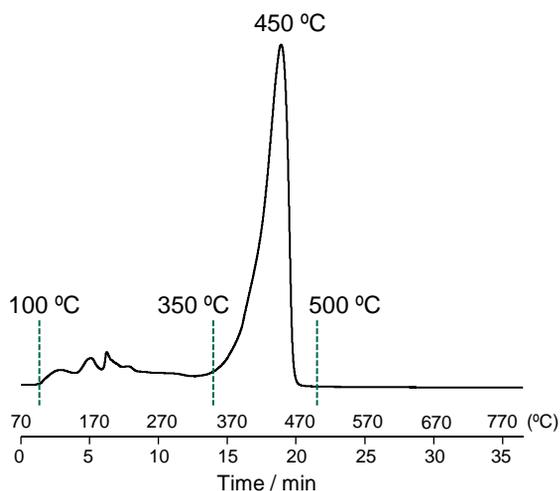


Fig. 1 EGA thermogram of a carbon dots sample.

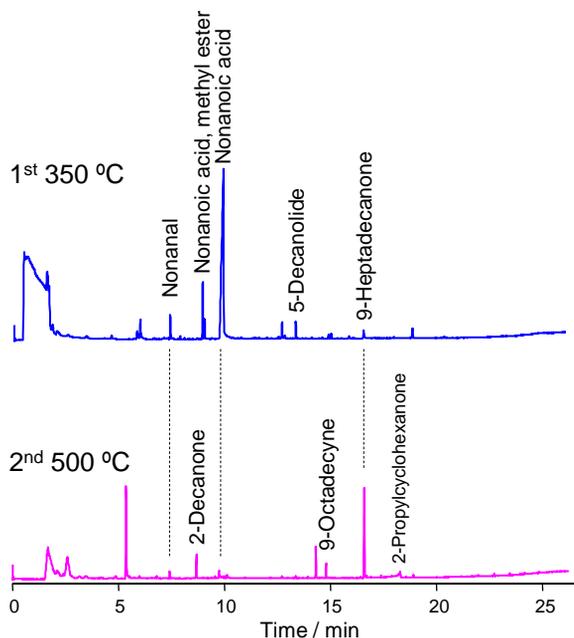


Fig. 2 TICCs of a carbon dots sample obtained by double-shot Py-GC/MS. 1st: 350 °C, 2nd: 500 °C.

* The contents extracted from a report prepared by Y. Huang, Z. Huang, and L. Wang.

Keywords : EGA, Double-Shot Py-GC/MS, Structural composition, Carbon dots

Product used : Multi-functional Pyrolyzer, UADTM-2.5N

Applications : Structural composition analysis of carbon dots

Related technical notes :

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