Area : Coal, Coke, Carbon Black, Graphite

Dependence of oxidation reactivity on optical textures of cokes and solid carbons and oxygen functionalities on carbon surfaces

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Oxidation reactivity and optical texture characteristics of solid carbons determine key properties that are relevant to a wide range applications of different carbon materials. Polarized-light microscopy (PLM) has been used to characterize the optical texture of cokes and carbons to assess the extent of microstructural anisotropy present in the samples. Directional properties of carbon materials such as thermal expansion is critically important in high-temperature applications, including the performance of graphite electrodes used in electric-arc furnaces for recycling scrap iron and steel. On another front, surface functionalities of adsorbent carbons affect their applications in adsorption processes or as catalyst supports in chemical reactions.

There have been studies to relate the optical texture of cokes to their oxidation reactivity using data from temperature-programmed oxidation (TPO) experiments. Also, TPO has been used to study the crystallographic order of graphitized anthracites to complement the analysis of these samples by x-ray diffraction (XRD). One advantage of using TPO and PLM characterization tools is the capability of detecting structural heterogeneity in the samples that may be averaged out in measurements such as XRD and coefficient of thermal expansion (CTE).

In this work, TPO has been used along with polarized light microscopy to analyse a wide range of anisotropic coke and carbon samples to study the relationships between oxidation reactivity and optical texture over a broad range of structural anisotropy. In addition, Temperature-Programmed Desorption (TPD) has been used to analyze the surface functional groups present in selected adsorbent carbons to seek correlations between TPO and TPD results.