

Analysis of HRTEM images of carbonaceous materials to extract quantitative nanostructure properties and correlation with their oxidative behavior

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The goal of this research was to study on how the morphology and microstructure of carbon particles affect their reactivity towards oxidation. The determination of the oxidation rate of carbonaceous samples is studied using thermogravimetric analysis (TGA) while for their structural investigation, an image analysis algorithm to extract quantitative nanostructure properties from High Resolution Transmission Electron Microscopy (HRTEM) images was developed. Through this procedure, known as lattice fringe analysis, information about fringe length, tortuosity and separation distance within primary carbon particles is obtained. The algorithm is implemented using MATLAB and in order to validate the acquired results, a comparison is made between the aforementioned results and those obtained by ImageJ analysis, a Java-based image processing program. Statistical results derived from the algorithm are presented in the form of histograms and show that the developed algorithm provides the capability to determine different carbon nanostructures between carbonaceous materials of various origins. Moreover, it is observed that fringe tortuosity and separation distance is an indicator of the structural order within these materials and thus an indicator for their reactivity.