



Fractal image processing and analysis using MATLAB programming

J. Zhang, Y. Ren, R.R. Zhang, B.Y. Hu and H.M. Liang

*College of Urban Construction of Hebei University of Engineering
No.199 Guangming South Street, Handan City, Hebei Province, 056038. China.
JZhangvip@yahoo.com.cn*

Abstract

The present paper studies the computing method of fractal dimensions by using the image storing principles of a computer. As an example of its application on char surface structure, by applying Matlab, the binary images and matrices concerning the surface pore were obtained by processing and analyzing the SEM photographs of char samples during combustion. The characteristics of binary digital images, have been minutely discussed based on the fractal theory that the principle and method of calculating SPFD is by use of dimensional box-counting.

Key words: *Matlab, SPFD, SEM, Binary image, Box-counting dimension*

1. Introduction

Fractal geometry is an excellent mathematical approach in the study of irregular geometric objects. 1) Fractal dimension can be indicative of some of the characteristics found within nature. 2) Therefore, the application of fractal theory allows for the description of the various stages of fragmentation and branching in biological and ecological systems (Burrough, 1981; Critten, 1997; He *et al.*, 1994; Milne, 1988; Nielsen *et al.*, 1997; Otto, 1996; West and Goldberger, 1987), amongst others. 3) The char is a carbon-based element composed of a complicated surface structure which processes fractal characteristics, and the char SPFD (surface pore fractal dimension) can reflect the process of char burning. Utilizing the powerful matrix operational functions of Matlab, the char SPFD of

SEM image can be obtained using Matlab language. 4) Matlab has a structured control language, making use of such constructions and conditionals as 'for' circulation, 'while' circulating, 'break' sentence and 'if' sentence which make up the programming characteristics used to depict an object. 5) In Matlab grammar restricted, the component writing program allows a large degree of freedom, and the utilization of this program is effective. 6) The figure functions of Matlab are powerful, provided various 'toolboxes' to be applied to image processing. 7) Because image processing takes place in a divided windows, using Matlab to compute SPFD, every pixel of the fractal image, as well as the result of box counting, can be observed as a whole. 8) In contrast, a program written with Vc++6.0 is unable to display the whole result. 9) This paper proposes a quantitative method to analyze the char SPFD from SEM images using image processing and