ABSTRACT

STUDIES ON METALLOGRAPHIC IMAGE ANALYSIS AND SYNTHESIS

Metallographic image analysis and synthesis of various interrelated images for reconnaissance applications are the potential areas of present and futuristic applications in material science, technology and engineering. The images of interest to be analyzed and synthesized may or may not have prominent high contrasted features. Therefore, conventional methods such as contrast enhancement or feature based extraction can not be used. **The major drawbacks/limitations of those techniques and the reasons for more failures than success in terms of structure-property and quality of materials is that they are susceptible to erroneous results that leads to gross errors in the development, production and quality control of technical materials to a great extent.** Henceforth, pixel and fuzzy theoretic set technique based shape identifications & measurements, pattern analysis & neural network based correlations estimations among images are the effective methods for these applications. Most commonly used approach is polygonal approximation in detecting prominent edge points for shape recognition. The work presents an algorithm which detect stable edge points based on Gaussian smoothed boundary obtained by using Gaussian filter at varied band width followed by a split and merge polygonal approximation algorithm. All the quantitative information such as shape, size and distribution of the inclusions in the microstructural image of materials are very much essential in order to determine the effects of inclusions on various properties of materials from their metallographic images.

An image analysis based on fuzzy set theoretic technique has been adopted in the quantitative evaluation of different types of precipitates in terms of shape, size and interspacing which are present in materials from their microstructure/metallographic images. Such quantitative estimates are useful to determine the effects of different precipitates on various properties of

materials.

An algorithm for comparative analysis of different patterns present in microstructural image of materials during heat treatment processes in course of their development, production and quality control has been developed. The population mean, population variance, size distributions and errors in pattern are computed in order to characterize each image and comparison is made among all the images in terms of time and temperature of heat treatment. A robust and straightforward method for analysis of various images to find out the correlations among these images which is based on a common technique from artificial neural network and it helps in synthesizing intermediate image. Most important task in artificial neural network is the learning mechanism which refers to the complex mapping from a data set. In the proposed scheme, image synthesis refers to the generation of intermediate image from various interrelated images.

All the algorithm tests are carried out on synthetic data such as microstructural image of chromium -molybdenum with various proportion and plain carbon steel materials in each case. All these metallographic images are obtained from scanning electron microscope. Scales of all images are 30μm/cm.

The highlights of this work are characterization of inclusions & precipitates, comparative analysis of various images and synthesis of intermediate images from various correlated images which would be very much useful for qualitative as well as quantitative assessment of service exposed materials.

KEY WORDS

Metallographic image, Inclusion, Gaussian filter, Detection, Polygonal approximation, Precipitates, Fuzzy set, Image analysis, Image synthesis, Artificial Neural Network, Scanning electron microscope, Optical microscope.