GRAPHICAL USER INTERFACE FOR VICKERS INDURATION TEST EVALUATION

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Abstract

An alloy induration evaluation provides one of the basic criteria in an alloy assessment and Vickers induration test forms one of the methods of induration evaluation. This standardized method is based on an alloy sample treatment with diamond tetragonal pyramid with a known load to gain standardized puncture. The area of incurred puncture is inverse proportional to induration of examined alloy. The MathWorks Matlab system was used for algorithm design and also for GUI providing easy batch interpretation of microscopic Al-alloy images. The application "Vickers GUI" was designed for complete indentation image processing. The Vickers GUI application was developed in Matlab system including its Image Processing Toolbox. It was compiled by Matlab Compiler to create a standalone application.

1   Introduction

Image processing methods provide a modern approach to data evaluation in various scientific fields. Methods of automated assessment of an experiment results based on processing of images taken with a digital camera find utilization in increasing number of applications. At the same time a very fast development of proper mathematical and algorithmic methods can be noticed. Specialized software products involving selected tools to 2D digital data processing are developed, as well.

Presented paper is focused on the development of the graphical user interface "Vickers GUI" solving the automatic indentation evaluation of an Al alloy. The algorithmic solution of the given problem helps to eliminate the influence of a human factor in the alloy assessment process. Together with an establishment of standard conditions under which the images are taken, it could have a significant contribution in the statistic reliability of the alloy assessment. This study introduces the first steps in the project which connects a standardized indentation method with an automatic image data evaluation.

2   Alloy Induration Assesment

Induration is one of the most basic material properties. A huge effort is devoted to the development of new materials with defined properties. An indentation measurement can be based on various principles depending on the other material property. In the case of metal alloy the Vickers' method [ČSN ISO 6507-1] can be used. Its principle consists in an evaluation of a puncture caused by a special diamond cone with a standardized shape (tetragonal pyramid with a top angle $\alpha = 136°$). An alloy sample is treated by means of this cone with known weight *F*. An alloy deformation and surface damage can be then explored by an electron microscope and images containing the alloy structure can be taken - Figure 1. In the simple case when the cone puncture is square-shaped, it is possible to determine puncture diagonals d_1, d_2. In the other cases a shape of deformation could be investigated.

Indentation evaluation by Vickers *HV* can be evaluated for the square-shaped puncture according to relation

$$HV = \frac{2F}{g}\sin\left(\frac{\alpha}{2}\right)\frac{1}{d^2} = 0.189F\frac{1}{d_1 d_2} \tag{1}$$

For more details about the Vickers' method of indentation evaluation, see ČSN ISO 6507-1.
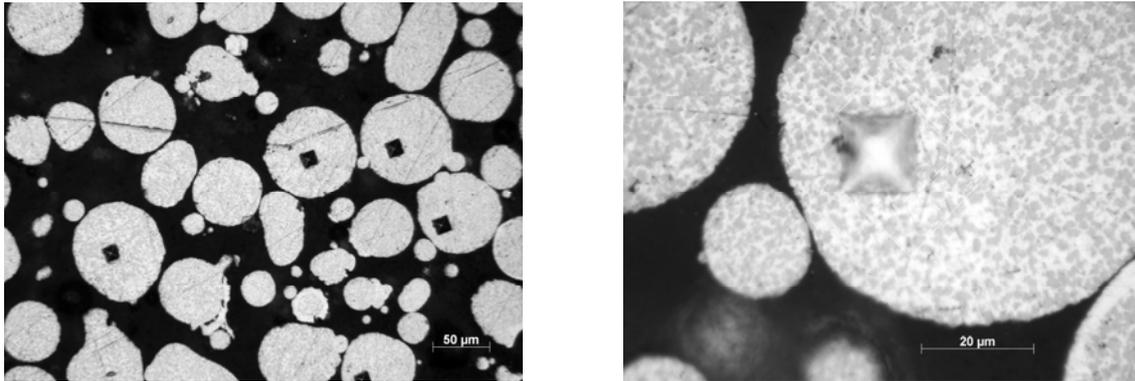
Figure 1: Examples of microscopic images with a puncture in various scales

3   Automatic Algorithm of Indentation Evaluation

It is possible to process selected sets of images obtained from electron microscope in a proper computational environment to obtain information about alloy induration. In the first approach a graphical user interface (GUI) in the Matlab system was proposed. Since some parameters of the microscope setup are set manually (like luminosity, magnification, etc.) the system of data storage must have been established at first to ensure correct image processing. Images are taken with a camera connected to an electron microscope and they are saved in the TIFF format with unique names. All important information is stored in the file header.

The Vickers GUI application was suggested with the goal of a simple use with maintenance of the possibility of manual setting of puncture diagonals at first, and with the respect to the following GUI extension to a fully automated processing of the whole file set. There is presented the GUI itself in a selected phase of work in Figure 2.

A GUI user selects only a folder containing a set of microscopic images and he loads all data into the environment in one step (by means of a pushbutton). The list of loaded images is then presented. In the following step the user can choose one image for evaluation. For good transparency and user's comfort, preview is prepared and it is separated from assessment, indeed.

Evaluation is executed in main axes of the GUI. Own measurement is selected by means of two special vectors. User takes end points of this vector, places them in the corners of puncture and diagonal distances in pixels is gained. This operation is still depending on user's experience only. The length of both diagonals is measured in pixels so it is necessary to convert them into the real units. The magnification constant is derived from a scale involved in the image.

The force parameter F must be known, as well. This value is still supposed to be a constant for the whole set of images, but it is simple to extend the GUI to make this parameter optional. An evaluation pushbutton confirms the indentation accomplishment and the resulting value of HV is immediately displayed and assigned to the corresponding image. A next image can be processed now. Eventually, the set of obtained values can be exported into a text file which is designed to be importable into various commercial applications.
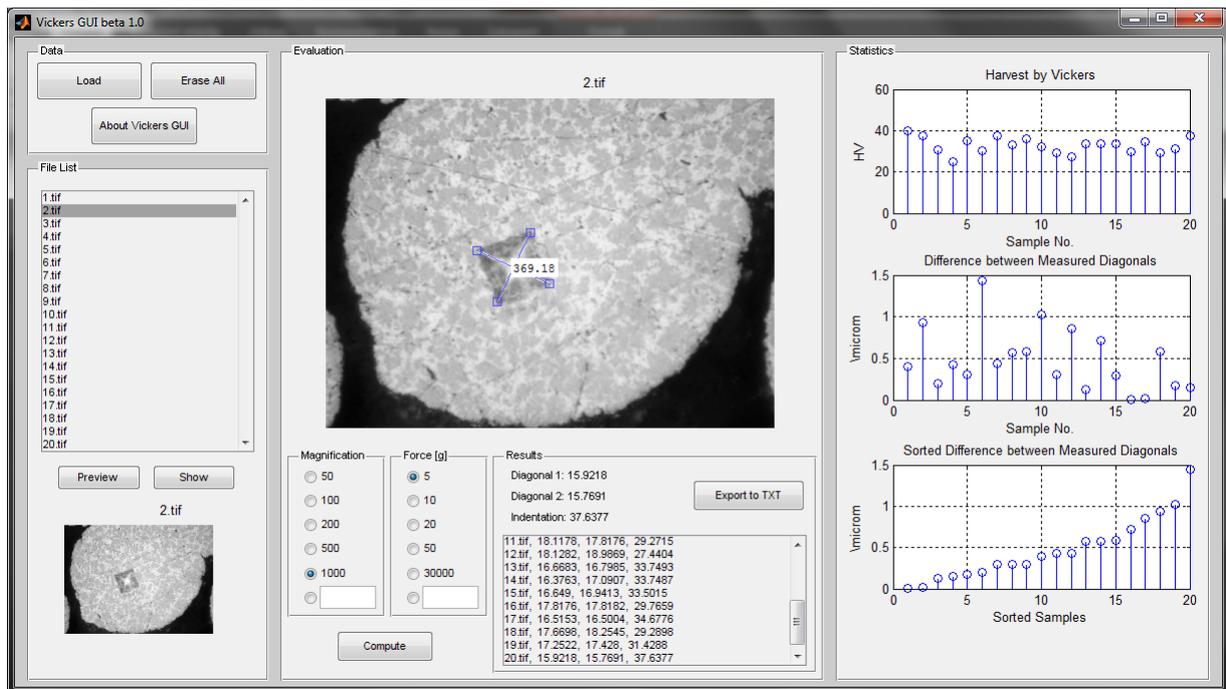
Figure 2: "Vickers GUI" - Graphical user interface for indentation assessment

4 Results

This project is focused on automatic evaluation of microscopic images of Al-alloy in indentation assessment. The graphical user interface was proposed as a proper approach to automate the evaluation process. The attention in this phase was concentrated on a cooperation of all programme units, proper data sharing and unit's communication. In the next step, implementing image processing methods for automatic puncture detection, its shape presentation and automated diagonals settings will be implemented to avoid user's influence for indentation evaluation.

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References

[1] ČSN ISO 6507-1. 1999. *Kovové materiály – Zkouška tvrdosti podle Vickerse. Část 1: Zkušební metoda.* Praha : Český normalizační institut, 1999. 5 s.

[2] DAVIDECSU, A.; SAVII, G. G.; STICLARU C. 2005. *Analysis of HVOF-sprayed MCrAlY Coatings using SEM Image Processing.* Journal of Optoelectonics and Advanced Materials (**6**), No.7, p. 3107 – 3110.

[3] GONZALEZ, R. C.; WOODS, R. E. 2002. *Digital Image Processing.* Second Edition. New Jersey (USA) : Prentice-Hall, 2002. ISBN 0-201-18075-8.

[4] LU, J.; RUAN, Q. 2006. *Aluminium Alloy X-ray Classification Using Texture Analysis.* 8th International Conference on Signal Processing, 2006. 16th – 20th November 2006, Beijing (CN).

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