An algorithm for detection of palladium nanocrystals in SEM images

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INTRODUCTION

Palladium (Pd) nanocrystals are of current interest due to their applications in sensor nanotechnologies. The aim of the project DeteH is to develop the technology of hydrogen sensor based on Pd nanocrystals embedded in carbonaceous matrix. One of the problems that have to be resolved is **the precise identification and measuring of the Pd nanocrystal clusters** embedded in carbonaceous matrix presented on scanning electron microscope (SEM) pictures (Fig. 1). The aim of presented studies is to automate this image analysis by dedicated algorithm implemented in Delphi.
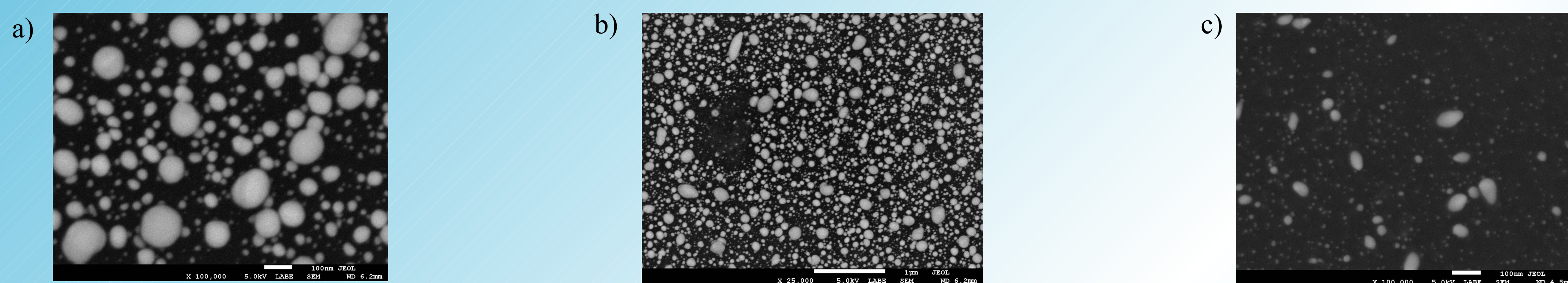

Fig. 1. Examples of SEM's LABe (Low Angle Backscattered Electron) images of Pd nanocrystals embedded in carbonaceous matrix obtained in CVD modification process: a, b) deposited on Al_2O_3 support; c) deposited on SiO_2 support.

RESULTS

A new algorithm and computer program was developed to solve the problem of Pd nanocrystal clusters identification, measuring and counting. The proposed solution is based on the analysis of the image gray levels. To determine the gray level threshold value for Pd nanocrystals and carbonaceous matrix (background) a quantile analysis of the gray level scale was used. The groups of adjoining Pd nanocrystal clusters were identified by neighbour's analysis and some recurrence algorithms. The gray level gradient was used to separate clusters inside a group. The matrix representation of nanocrystal clusters in the picture was than used to counting and measuring the clusters.

The output values of the algorithm may be exported into a text file or presented by using tools of the program (Fig.2).
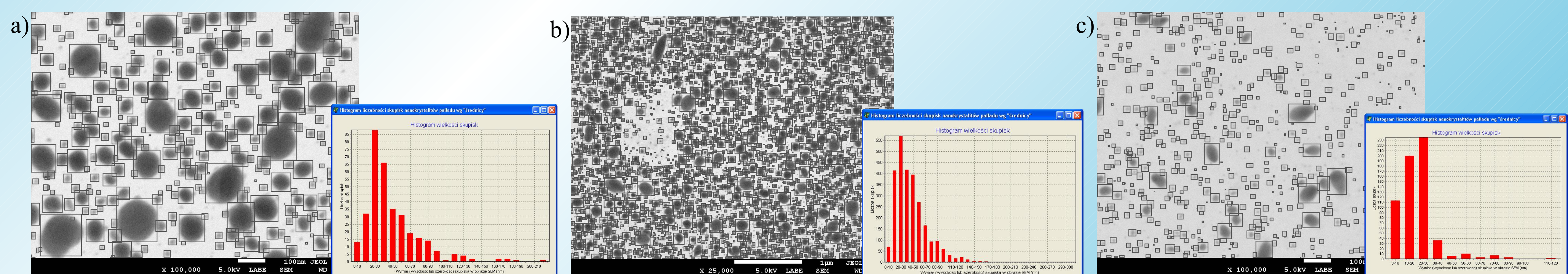

Fig. 2. SEM's LABe images from Fig. 1 (negatives) with identified Pd nanocrystals clusters and correlated histograms of the clusters sizes

CONCLUSIONS AND FUTURE WORKS

A series of tests have shown that the algorithm for detection of Pd nanocrystals clusters in SEM's image is an efficient and reliable method. The class of images considered in the work is limited to SEM's LABe images. Further work on image processing algorithms for SEM's SEI (Secondary Electron Image) images need to be performed. It will allow to compare the SEM's LABe images with corresponding SEM's SEI images and to measure the thickness of carbon shells surrounding Pd nanocrystals clusters.

The algorithm and the computer program will be developed to improve their time efficiency and ability.