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AUTOMATED MEASURING SYSTEM FOR MEASURING ELECTRIC PARAMETERS ON THE SILICON NANO-COMPOSITE

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ABSTRACT
The research paper is based on silicon nano-composite samples (4 types). These samples were prepared in Australian National Laboratory Canberra with ion implantation. Three of them with different density of Si-atom (A=$3\cdot10^{17}$ ions amount/cm^2, B=$4\cdot10^{17}$ i.a./cm^2, C=$5\cdot10^{17}$ i.a./cm^2) and one without this layer (blank). For the detection of the transport characteristics and the surface of these samples an automated measuring system (AMS) has to be designed and constructed. This system is resistant against electro-magnetic radiation (EMR, only for low frequency) and light. The precision LCR meter (HP 4284A) was used. Humidity and temperature sensors are inbuilt in the AMS. Transport system is used for moving of the sample (3 pieces of ultra-high resolution motorized translation stages providing linear motion, M-110.1DG). The AMS is connected to computer by technological card (National Instruments, NI PCI-6229). The instruments are connected to computer via GPID interface (NI PCI-GPIB). The application software is created in the development environment LabVIEW. The measured data are automatically saved to computer for later processing. The description of automated measuring system and results will be presented.
Keywords: measuring, silicon nano-composite, LabVIEW

1. INTRODUCTION
The development of nano-composite (n-c) materials undergoes a great expansion in the last time. This discipline has possibilities of application in energetic, aviation or cosmonautics. The nano-composites will be used as sensors [1, 2, 3], lasers [4, 5, 6] or systems for data processing [7].
The aim of the discipline called nanotechnology is goal-directed and accurate control of single atoms and molecules to create a new microscopic object, e.g. integrated circuit, 1000 times smaller than current circuits produced by current technology.
For the research of n-c materials it is responsible correct apparatus to using. It is very responsible occupy oneself with sphere of the ambient conditions and cut-down their effects.
Therefore needs attend to measured area

2. EXAMINANTE SAMPLES
The experiment is based on samples prepared in Australian National Laboratory Canberra with different density of Si-atom (A, B, C, Table 1.) and one without this layer (blank, Bl). These samples were prepared with ion implantation.

Table 1. The list of samples.

Sample label	Bl	A	B	C
Dose [ions amount/cm^2]	0	$3\cdot10^{17}$	$4\cdot10^{17}$	$5\cdot10^{17}$

Figure 1. show the schematic sample profile.
Blank sample without the layer of silicon ions was made in order to compare measured values of the nano-layer samples with this sample. Figure 2. show actual size of the samples.

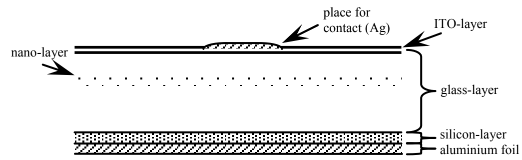


Figure 1. Schematic sample profile.

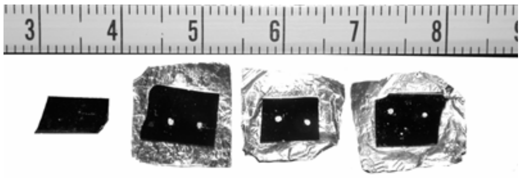


Figure 2. Dimensions of the samples.

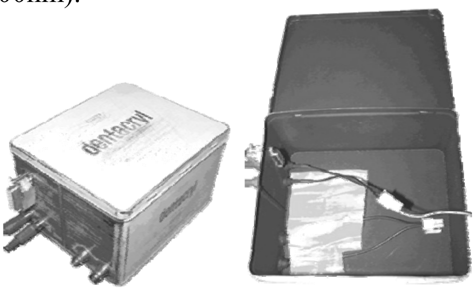
3. AUTOMATED MEASURED SYSTEM (AMS)

Development of the AMS was divided in two parts:

1. Design and construction of the testing measuring cell.
2. Design and construction of the automated measured system (final version).

3.1. Testing measuring cell (TMC)

Constructing the TMC is important to research affect of the ambient conditions.
There is constructing from metal box for resistance of electro-magnetic radiation (Figure 3.a). Inside is applied special mixture of black colour and ZIPPO-petrol for elimination of light (Figure 3.b).
The cell is equipped with illuminative system, which is connected with double-sided connector (canon 15pin, Figure 4.). Measured devices are connected with the TMC with 2 CINCH and 2 BNC connectors (Figure 4.).
The illuminative system (Figure 5.) is consists of eight LED diodes, always 2 pieces of one's colour together. There are use white (Semic Trade, HB5-439AWD-C), red (Kingbright, L-53SRC-E, 660nm), blue (Kingbright, L-7113QBC-D, 468nm) and ultraviolet (UV, Kingbright, L-711UVC, 400nm).



a) b)

Figure 3. View of the TMC

Figure 4. Illuminative system.

3.2. Automated measured system

The goal of the AMS is measuring in agreement with predefine algorithm, without human intervention into measuring area. Measuring cell (MC) is designed with robust metal body.
There is divided into two parts – room for electronic (left part) and room for measuring (right part).

Room for electronic – PC micro-source (Fortron, FSP200-50SNV) and two terminal strips (Nationals Instruments, CB-68LPR) are set there. Micro-source is used to supply for electronic in MC (temperature and humidity sensors, illuminative systems). Terminal strips are used to connection with technological card (National Instruments, NI PCI-6229) in PC.

Room for measuring – Temperature sensor (Analog Devices, AD590LH) and humidity sensor (Hih-3610) are set there. Transport system is used for moving of the sample (3 pieces of ultra-high resolution motorized translation stages providing linear motion, M-110.1DG). The inside of AMS is lit up bay two lightings tubes (Sharkoon, ColdCatode, White).
At present it is measured only on TMC. The final version of the AMS is under development.

4. MEASURING WORKPLACE

4.1. Dissipation factor

The dissipation factor (D) is measured on samples prepared with ion implantation. It was detect variance behaviour on the change of the illuminative. On this type of samples is measured dependence of the illumination.

List of used device – precise LCR bridge HP 4284A, DC source Agilent E3632A, PC, GPIB card (NI PCI-GPIB), TMC with illuminative system and SW HP Vee Pro v.7.5.

The LCR bridge is used to generate sinusoidal wave and for measurement of the D. The source signal was adjusted with amplitude 1V in the range from 10 kHz to 100 kHz with a step of 2 kHz. The parameters were read 3s after stabilization. Five values of D were measured for each frequency. These values were used to obtain the average and the standard deviation. The time interval between the readings of values was 1s. The lighting system was powered by DC source (3V).

Computer control and data collection from the apparatus was implemented. The connection between the apparatus and the computer is shown in the Figure 5. The instruments are connected to computer via GPID interface. The application software (DCh – dissipation characteristic, Figure 6.) in the development environment HP VEE was created. The measured data are automatically downloaded to computer for later processing.

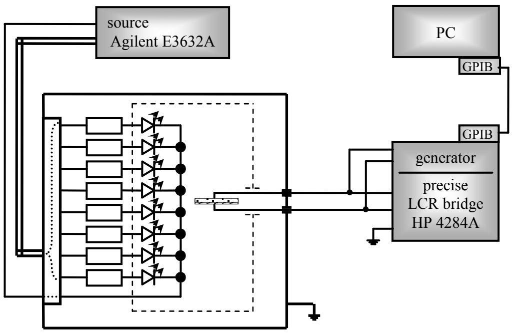


Figure 5. The connection the apparatus.

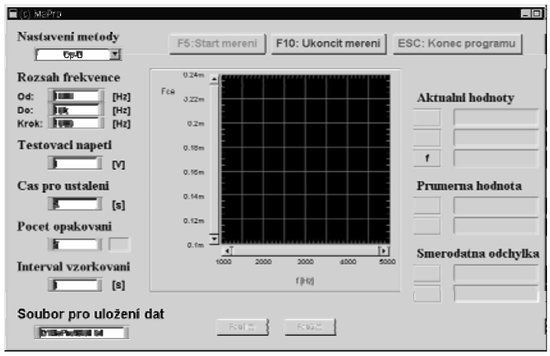


Figure 6. The application software DCh.

4.2. Surface of the samples

Detection of the surface is an alternative method for description of the samples. Transport system is used for moving of the sample under the sensor. Detection proceed via precise LCR bridge HP 4284A. Capacity and Dissipation factor is measured. The scan range is 5mm x 5mm large (maximum) with a step 50nm (minimum). This range is dependent of the used transport system.

This method is now in testing procedure.

4.3. Software for automated measured system

The final version of the AMS is under development. The software is only in beta-version (Figure 7.) and it is created in the development environment LabVIEW v.8.0. This software is used for measuring of the surface of the samples.

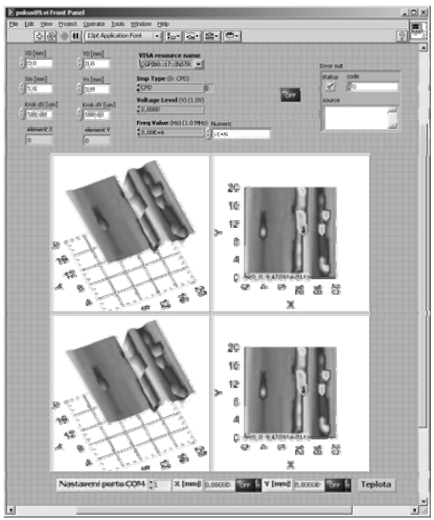


Figure 7. The beta-version of the software for control of the AMS.

5. EXPERIMENTAL RESULTS

The experimental results are measured only in TMC.

Four samples (blank, A, B and C) were measured. The experiment was accomplished for 4 different lightings – white, UV (400nm), blue (468nm) and red (660nm) (the white is not shown in graphs, it is not clean white) and darkness. Ten different measurements for each sample were obtained. The experiment was done several times to provide repeatability. All the measured data and characteristic show that standard deviation is less than 2%, therefore the deviation is not included in graphs.

Figure 8. shows responses D(f) from the blank sample (Bl). In Figures 9.-11. can be seen responses D(f), it shows differences between blank sample and samples A (Figure 9.), B (Figure 10.) and C (Figure 11.).

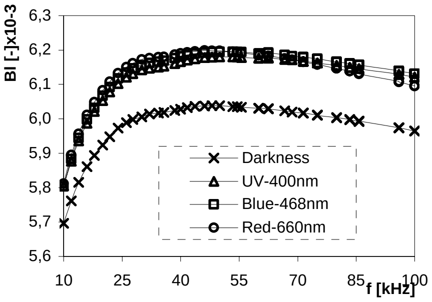


Figure 8. Behaviour of blank sample.

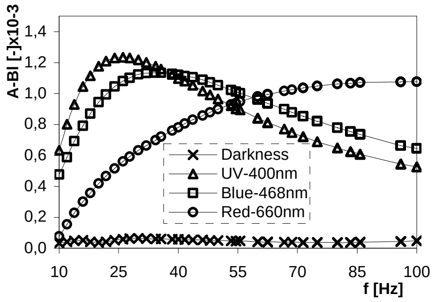


Figure 9. Behaviour of sample A.

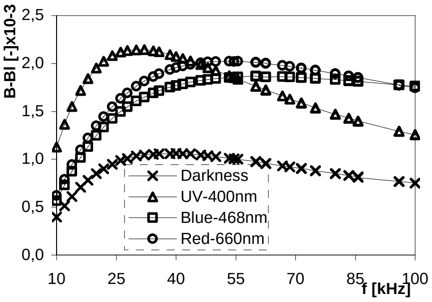


Figure 10. Behaviour of sample B.

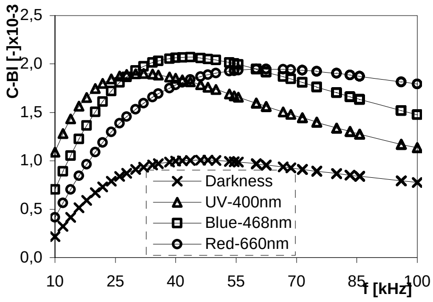


Figure 11. Behaviour of sample C.

6. DISCUSSION OF RESULT

All measured data (Figure 13. - 21.) are only informative, to constructing of the final version of the AMS.

7. CONCLUSION

The goal of our work is construct the measured cell for the detection of the transport characteristics and the surface of samples.

8. ACKNOWLEDGEMENT

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