CONTROL OF THE SYNTHESIS PROCESS OF SUPERCONDUCTING MATERIALS

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Synthesis and oxygenation of high-temperature superconducting specimens is a complex process [1,2], which in order to obtain an optimal result requires the settling of such problems as: achieving in the oven an exactly fixed temperature in the definite time; temperature rate control; the given temperature stability in a desired time interval; visual control of the going process parameters, etc.

Fig.1. Unit MEISSA

On the basis of these requirements a device MEISSA has been developed to control and record data in a system for oxygenating high-temperature superconducting specimens *(Fig. 1)*.

The oxygenation process of specimens is going in a high-temperature compact continuous cylindrical oven. It accommodates a quartz pipe (Fig. 2), containing, in turn, test specimens. A K-type thermocouple is mounted in the same quartz pipe as a temperature transmitter; the control scheme is built on the OMEGA-made SN7200 temperature controller.

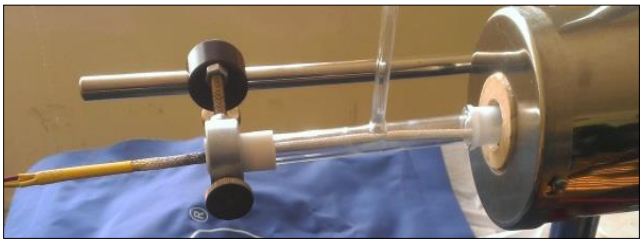

Fig.2. Quartz tube with thermocouple

The schematic circuit of the MEISSA unit is given in Fig. 3.

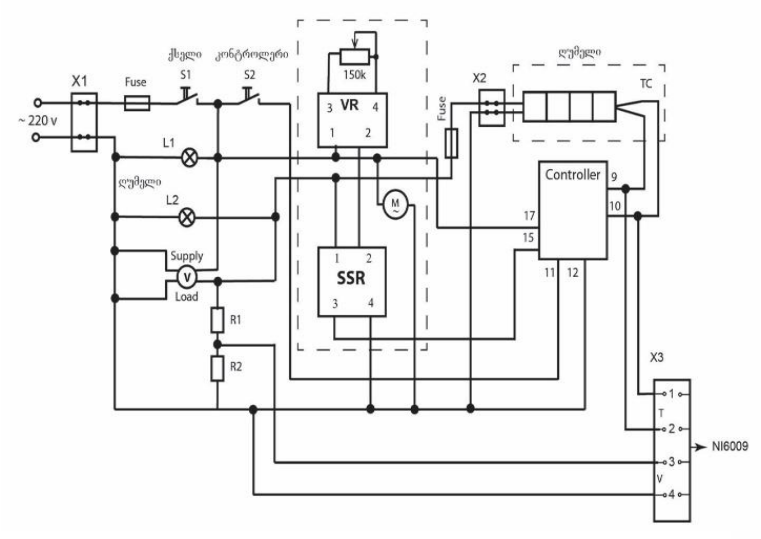

Fig.3. Schematic circuit of the MEISSA unit

For more comfortable control over the technological process, visualization and memorization of the current physical parameters, the National Instrument NI USB-6009 multifunctional I/O device has been added to the system. Information about the current temperature and oven voltage is supplied from the MEISSA unit at its input, the output being connected to a personal computer. LabView - a software using graphical diagrams to create virtual instruments, enables making a virtual device on a PC monitor [3-5] for demonstrating the technological process.

The front view of the created virtual device is depicted in Fig. 4, while the flowchart in Fig. 5.

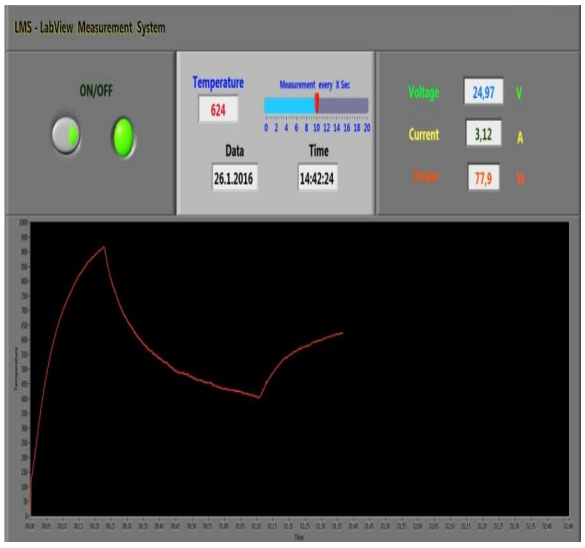

Fig.4. Front panel of the virtual instrument

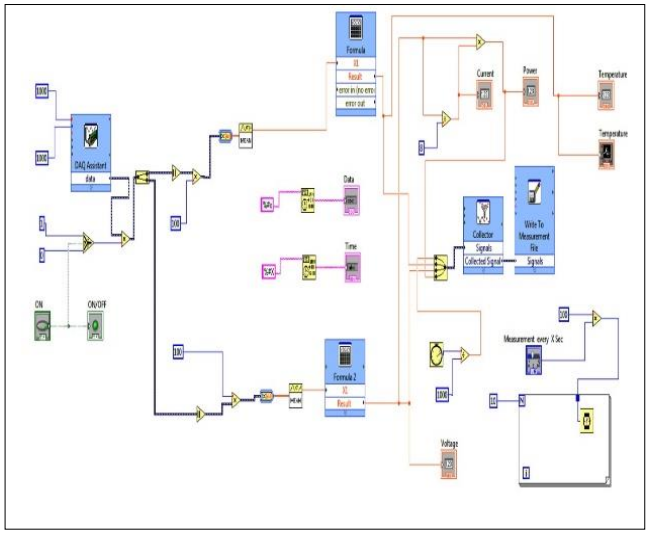

Fig.5. Block diagram of the virtual instrument

Thus, MEISSA – a device for controlling and data recording the system of high-temperature superconducting specimens' synthesis in the oxygen environment has been designed and manufactured. It allows for oxygenating superconducting specimens placed into a compact continuous cylindrical oven under different algorithms of temperature conditions, its temperature stability within 20÷1000 ^{0}C not exceeding ±1 ^{0}C. The process control is exercised by the OMEGA-made SN7200 temperature controller; as for data organization and communication, it is ensured by the National Instrument NI USB-6009 multifunctional I/O device. The current technological process parameters can be controlled both on the front panel of the physical device, as well as on the front panel of the virtual device created in a PC environment by the graphical diagrams of the LabView software. Similarly, the automatic recording of data in a PC takes place in the form of Excel files. The device has been functioning for several years now and has proved itself as a simple and reliable operational tool for controlling ovens of different type.

Acknowledgments

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REFERENCES

1. Metskhvarishvili, T. Lobzhanidze, G. Dgebuadze, M. Metskhvarishvili, B. Bendeliani, V. Gabunia, "HgBa2Ca2Cu3Oy Superconductor Prepared by As Vapour Diffusion Process" Nova Science Publishers, Book, 2016.
2. I.Metskhvarishvili, G.Dgebuadze, B.Bendeliani, M.Metskhvarishvili, T. Lobzhanidze, L.Gugulashvili, "Low-Field High-Harmonic Studies in Hg-1223 High-Temperature Polycrystalline Superconductor", Journal of Superconductivity and Novel Magnetism, 28 (2015) 1491
3. Jianghua Bai, Andres La Rosa Essentials of Building Virtual Instruments with LabVIEW and Arduino for Lab Automation Applications, International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Volume 6 Issue 5, May 2017 pp. 640-644
4. LabVIEW for Everyone: Graphical Programming Made Easy and Fun,3rd Edition Prentice Hall; New Jersey, USA, August 6, 2006, pp.1040