Automation of Quasi-Closed Space Method Based on ARM Microcontroller

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The main advantage of the condensation method in the quasi-closed space is the ability to realize condensate growth under conditions close to thermodynamic equilibrium, which ensures high quality obtained films crystal structure [1, 2].

For the implementation of these conditions, we need to create a low vapor supersaturation on the surface of condensation. In a closed, pre-evacuated, isothermal volume is set uniform vapor pressure equal to the value of the equilibrium pressure of the evaporated material at a given temperature. The temperature dependence of the vapor equilibrium pressure describes by the formula

$$lgP = -AT^{-1} + B,$$

where A and B are constants for a given substance.

Thus, the film condensation conditions in a closed space are set by temperatures of evaporator and surface on which the condensation is conduct. Taking into account, that pressure logarithmically depends from the temperature, at the film condensation at low vapor supersaturation the value of temperatures in chamber zones should be maintained in the range from 400 up to 700 °C with an accuracy no less than ±1°C during the entire process of film deposition. Such precision and constant temperature control requires the use of automatic control based on microcontroller's with modern architecture.

Based on the technical requirements for technological processes of quasi-closed space method was developed circuitry of automated control system. A block diagram of an automated system shown in Figure 1.

The system consists of the following blocks.

A1. Vacuum block in the evacuated space. Contains heating elements of QCS chamber zones and thermocouples for temperature monitoring.

A2. The control unit based on 32-bit ARM architecture microcontroller, for example, ST32F4 series. Designed to control the heating elements of the vacuum unit, as well as for display, data acquisition and processing.

A3. The measuring unit based on ASM 801 complex B to convert the thermocouple signal of vacuum unit and transfer them to the control microcontroller.

A4. Multivoltage power supply block of automation system.

A5. Block for display of system operating modes.

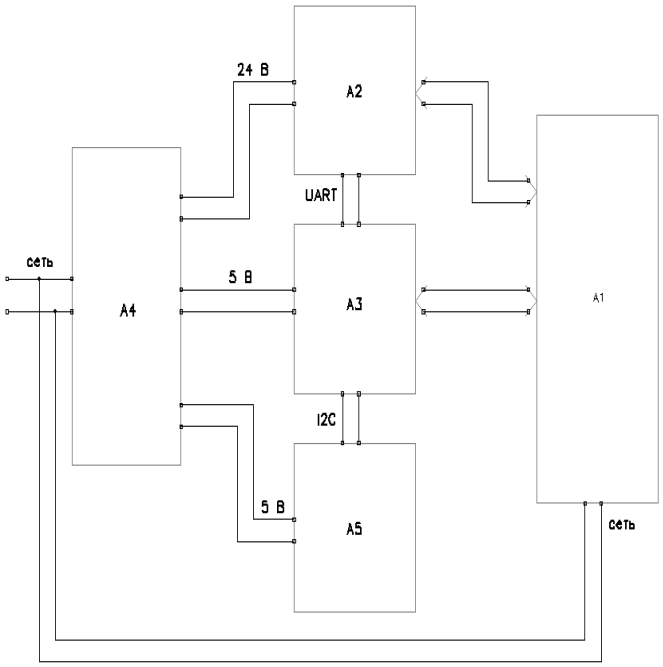

Fig. 1. A block diagram of the QCS method automation system

Technically the proposed automation system can be implement on the available and widely distributed controllers, such as Arduino and Raspberry, will provide the necessary precision of QCS chamber temperature zones control, and will allow to fully automating the process of applying thin films by this method.

References

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