PID-Controller Application in the System for Variable Technological Process

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***Abstract*—This report concerns the automatic control system based on the programmable controller TRM-151-01 of the temperature of semiconductor alloying with zinc and tellurium. The goal of the research is the industrial modernization of the epitaxial growth technology of semiconductor materials in the form of thin multiple layers (inclusively nano-dimensions) with variable values of the electric conductibility.**

Keywords—automation; epitaxial layer; gallium compounds; tellurium alloy; zinc alloy

I. INTRODUCTION

It is known the importance of automatic digital controller [1] that allows increasing the industrial technologies productivity, improving the quality of products and increasing the economical parameters that underlying the creation of offers oriented to satisfy customers' requirements. Currently, the components that form the structure of automatic control systems (ACS) are implemented in production on the large industrial scale and presented extensively on the global market by the manufacturing companies such as Siemens, Mitsubishi, Omron, Schneider Electric, etc.

One of the actual problems in industrial automatization is related to systems engineering including design, installation, adjustment and exploration of systems and solving these problems are connected with the quality of ACS. The process of adjustment of the automatic systems consists in several steps, but the procedures of identification of the control object, compensation of perturbation signal in the system and parametrical optimization of the ACS, represent not only the practical value of experimental researching but also a scientific interest.

Therefore the control object is a complex technological process of different nature, which determines the quality of the finished product, in his turn is subject to periodic changes and the quality of control the ACS must fulfill the technical requirements of this process. Therefore adjusting ACS generates steady interest for engineers and researchers.

The authors of this paper intended to modernize in the industrial plan the technological process of epitaxial growth of the semiconductor materials in the form of thin layers (inclusively nano-dimensional) with variable values of electrical conductivity.

II. GROW THE SEMICONDUCTOR STRUCTURES

A. Technological process of GaAs epitaxy with reaction transport.

The growth of semiconductor structure with multi-layers for different applications by utilizing the method with reaction transport in gas system $AsCl_3$-Ga-H_2 is produced in technological installation IEC-3/4R with quartz horizontal reactor at low pressure *(p*=10-100 *Pa)*. In Fig. 1 is shown the principle scheme of gas fluxes. In the picture the simple arrow indicates the electrical signals, figurative arrows – gas fluxes.

B. Technological process of GaAs alloy.

Technological process of semiconductor structure alloy is very sensible and determines the product quality. It is responsible for charge carrier concentration in the epitaxial layer. It determines principal requires for the automation adjustment of zinc and tellurium gas fluxes generated in OR1, but it being controlled by measurement of the vapour sources temperature at the entry of reactor.

The vapor fluxes have a value settled by the operator and a variable dynamics in the growth process of structures with many programmable layers. Quality parameters of adjustment are determined by the synthesis method with setting task performance [3,6,7,8] from requirements of technological processes, which are produced in reactor as opened control object OR2.

There are following designations in Fig. 1: OR1 – first control object (vapor produce); OR2 – second control object (growth layers); R1 – vapor flux automat control; K – reference signal converter; H – hydrogen flux; F_n – vapor flux;

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