Review on Heating Element Strip & Temperature Control Using PID Controller

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Abstract— The review explains use of a high temperature silicon carbide material for heating purpose. Electrical field resistance heating gives avarious types of materials which are available as heating elements and one of its most important application is temperature Control by using Proportional – Integral - derivative (PID) controller. Where it consists of a control feedback system to be used widely in industrial control system.

Key words: Heating Element Strip, Temperature Control, PID Controller

I. INTRODUCTION

Silicon Carbide (SiC) is a semiconductor material has great interest in high temperature applications with wide band gap [1]. SiC power devices are used in very large temperature variations for power computers, region applications, radio and television broadcasting, railway engines, nuclear power stations [1]. PID controllers also employed because of their simple, robustness, a large vary of relevancy and near-optimal performance. Most of control loops are of PI or PID structure are available [2].

II. LITERATURE REVIEW

"High temperature characterization system for silicon carbide devices" explains the new architecture for a temperature characterization system used for SiC devices up to 800^{0}C [1]. In PID Controllers: Design and Tuning Methods paper a parallel form of a proportional-integral-derivative controller was implemented the form of the PID controller by Sudhir Ranjan et al. The heart of this system is ATMEGA 16 microcontroller [2]. This is conducted on auto tuning mechanism as well as data acquisition and PID control mechanisms in this paper processes are attempt. Plant consists of a cooling unit (Air conditioning mechanism), a RTD sensor and a microcontroller that are encapsulated in a small testing room. The RTD sensors Pt 100 can detect temperatures in a wide range of 200°C to 850°C and are highly accurate is described by SudhirRanjan et al.

III. DESCRIPTION

In the field of electrical resistance heating used as heating component. Silicon carbide (SiC) exists solely as a solid and because it has no liquid section, the material is rigid at all practical operating temperatures.

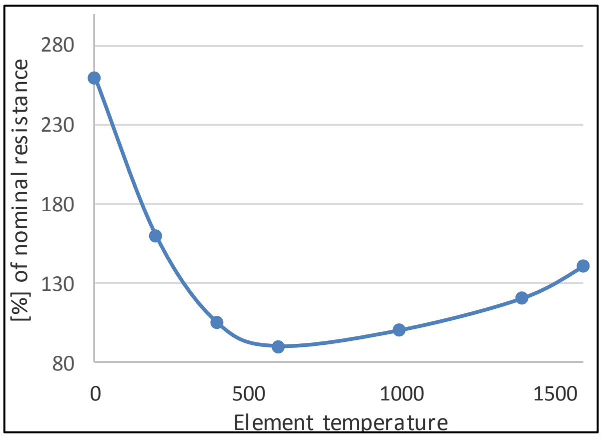

Fig. 1(a): Characteristics of SiC

Fig.1(a) characteristics of Silicon carbide elements change in resistance with respect to temperature. The resistance is fairly high at temperature, falls with increasing temperature to a minimum value at about 800°C, and then increases with temperature. For this reason, any resistance measurements should be taken at element temperatures above 800°C and should be based on voltage and current readings taken from the element. Specified silicon carbide component resistances square measure measured at component temperatures between 1000^O and 1090°C, depending on manufacturer. Figure 1(a),1(b),1(c) shows this characteristic.

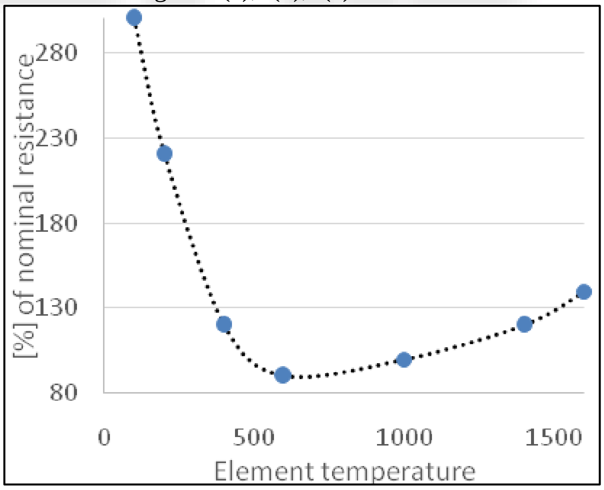

Fig. 1(b): Characteristics of SiC

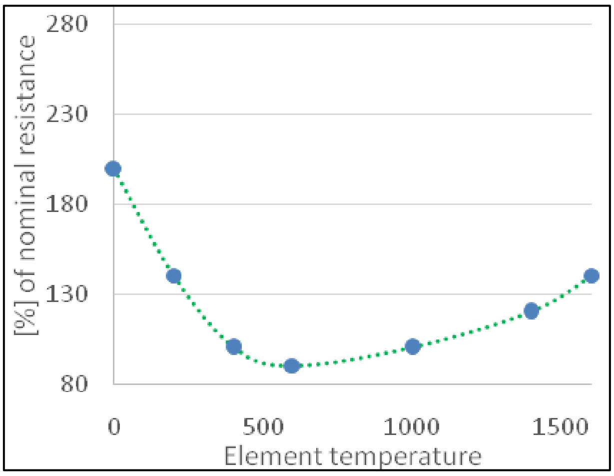

Fig.1(c): Characteristics of SiC

Fig.1(c) characteristics of SiC the above show aging and temperature dependent resistance. Typical carbide includes a most suggested component temperature of 1650°C (~1600°C chamber temperature) though metal disilicide component can usually be most popular for prolonged use on top of above 1500-1550°C. There are some semiconductor carbides material used (developed in Europe) that square measure designed for continuous or intermittent expend to 1600ºC furnace temperature. This material is limited with respect to physical sizes available[1].

A. PID Controller

One of the most important applications of PID control is to control temperature and maintain it to desired value. In order to meet this application one must employ certain control mechanisms. PID Controllers are widely used in industrial applications because of their simple and robust construction. There have 3 coefficients: proportional, derivative and integral coefficient. By tuning these coefficients to specific values, the desired functionality of the PID control can be achieved. The demand for accurate temperature control has always been prevalent in various domains such as homes, industries or office buildings where the temperature is maintained in order to maintain a comfortable environment for its inhabitants[2].

The Control System Design for Temperature Control:-

In this perusal a parallel form of a proportional-integral-derivative controller was implemented. The form of the PI (inflammatory disease) controller time domain is expressed as:

$$U(t)= K_{p}.\int[1+ \tfrac{1}{s}.T_i + s.T_d].E(t)$$

Where: $E(t)$ is the signal error

$U(t)$ is the control input to the process

K_p is the proportional gain

T_i is the constant of integral time

T_d is the derivative time

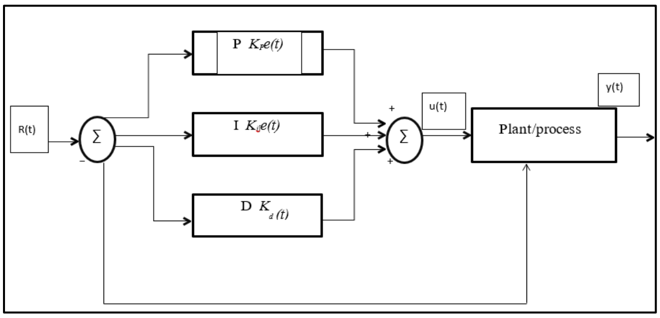

Fig. 2: PID Controller

B. Method 1: Trial and Error

	Rise Time	Steady State	Overshoot
Proportional	Decrease	Decrease	Increase
Integral	Decrease	Eliminate	Increase
Derivative	None	None	Decrease

Table 1: Trial & Error

Trial and error method is fundamental method of problem solving. Closed loop system is important for trial and error method; each and every step of the system goes through proportional to integral and again to the derivative method. In This method first find the rough solution to get best response. At starting, constant of the (coefficient) PID controller is set at particular value zero. The component of proportional is considered as to be increasing its value till a steady oscillation is not obtained. Scaling the present proportional value get down by two factor of the ensuing proportional factor. Proportional value is applied, then cancels the steady oscillations. In next step Integral coefficient constant value is increased until steady oscillations is again obtained. The present integral coefficient is increased by a three in factor value and final value applied to the integral. This another time consider oscillations zero, which give chance to derivative control, this value is continuously grade up until it gets some constant oscillations period and amplitude. The coefficient of the derivative is then value decayed by a three and applied to derivative control.

IV. CONCLUSIONS

A semiconductor devices characterization system with extended capabilities at high temperatures is projected and enforced. A DC power amplifier heater is used to accreting control furnace temperature. By reviewing all the design and tuning methods of PID controller are found. Process model identification, PID controller structure design, PID parameters tuning methods, the use and expansions of PID are described and the adequate application for temperature control in an air conditioning ventilation system using the Atmega 16 Microcontroller is efficient. [2].

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