

PERFORMANCE RANGE TEST OF GIANT MAGNETORESISTANCE SENSOR FOR FERRIC CHLORIDE MEASUREMENT

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Abstract

This research have tested performance range of the GMR sensor on Ferric Chloride concentration measurement. Performance range is one of the characteristics that must be owned GMR sensors to determine the limits of measurement. The performance range of the measurement system ferric chlorit concentration determined by performance range of the GMR sensor. GMR sensor sense magnetic field which has been designed as object disturbance. Sources of magnetic field generates field strength of 0.97 Tesla. Methods of testing done by putting the GMR sensor at a distance of 0 to 24 cm of the magnetic field source with variations 1cm. Each variation of the distance sensors determine the output voltage of the GMR sensor. Range limits determined by the state of saturation of the sensor as the upper limit and the state cut off as the lower limit. Tests were performed using two-way coordinate axes, namely the X axis and Y axis. GMR sensor range test results on the X-axis direction has a saturation 258,2mV at a distance of 5cm and cut off at a distance of 18 cm 6,8mV on. Testing the GMR sensor range on the Y-axis direction has saturation 260,1mV at a distance of 6cm and cut-off at 17mV at a distance of 22 cm.

Key words: GMR Sensors, Performance range, measurement Ferri Cloride

INTRODUCTION

The development of sensor technology and instrumentation increase competitively. Vendors Companies that produce a wide range of instruments is also competing to show the advantages of each. Do not miss the institutions both public and private research also participate actively develop sensors and applications. Various groups of expertise in college also vying develop the sensors and sensor systems are superior. Every manufacturer, developer or a group of researchers of each sensor or instrument to develop products with the advantages of each. Excellence sensor or instrument can be determined some static parameters and dynamic parameters . Static parameters of the sensor is a parameter that does not depend on the time such as accuracy, precision, range, resolution, hysteresis, linearity, tolerance and others. While the dynamic parameters of the sensor or instrument is a time-dependent parameters such as the dynamic response of first order and second order dynamic response [1] [2]. This study focuses on the range of a sensor testing.

Range or span a range of minimum to a maximum value of a variable can still sensed by sensor or measured by the instrument. Testing range can be determined based saturation and cut-off state, the maximum-minimum state and linear range. The benefits of knowing the range of the sensor is that it can be used to design an instrument for estimating the value of the variable to be measured. This study examined the GMR sensor range that will be used for the measurement of Ferric chloride.

Sensor Giant magnetoresistance (GMR) is one magnetic sensor has a high sensitivity, low cost, and low power consumption [3]. GMR sensor works by major obstacle change when there is a change of magnetic field around it. Giant magnetoresistance was first discovered by Baibich in research group in 1988 [4]. In concentration measurements of Ferric chloride solution, required GMR sensors and permanent magnets. So that measurements can be eaten to design directional magnetic field and the testing range GMR sensors. Range sensor or instrument is determined by the saturation and cut-off state. Testing should be conducted to determine the range of one instrument performance. This is because the range of the sensor will affect the quality of the measurement, assignment or recording of the measured values [5].

RESEARCH METHOD

Ferric Chloride concentration measurements in this study using the concept of ferric chloride solution flow that has been magnetized and then sensed by GMR sensor. Magnetization of Ferric chloride solution requires a magnetic field around 1Tesla. This study uses four permanent magnet for magnetization, iron pyramid shape, Teslometer, power supply, digital multimeter and GMR sensors as shown in Figure 1. Four parallel magnetic arrangement then closed with two iron pyramid shape. (Figure 1a). Fourth 0,45Tesla magnets have a magnetic field, it is far from the target 1Tesla. Therefore made to focus its pyramid-shaped iron (direct magnetic field) in order to obtain a large magnetic field. The results of magnetic field measurements is showed 0.97 Tesla (Figure 1b). Magnetic field sensed using GMR sensor that is connected to a digital voltmeter and Power supply (Figure 1c).

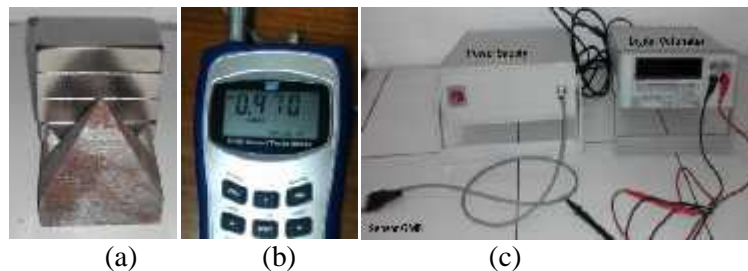


Figure 1. (a) the magnetic Permanent and iron pyramid
 (b) Teslometer to measure permanent magnetic field
 (c) GMR Sensor, Power Supply and Digital Voltmeter

Testing the GMR sensor range is shown as Figure 2a. GMR sensors will sense magnetic field along the X axis and Y axis starting from the origin at the top of the pyramid with the variation within 1cm. GMR sensors are connected to a reference voltage source $V_{ref} = 5 V_{out}$ of the power supply and connected with a digital multimeter to measure the output voltage V_{out} . GMR sensors integrated in a Wheatstone Bridge circuit which has three resistors with values 5kOhm. The next step is determining the reach of the GMR sensor by determining the saturation value to the maximum value and the value of the cut-off for the minimum value.

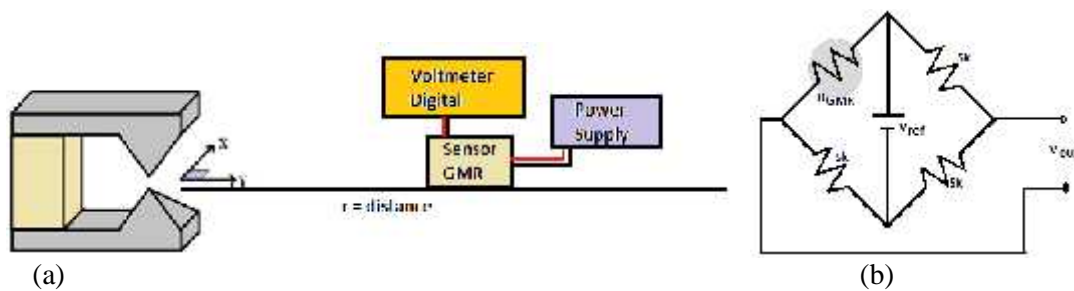


Figure 2. (a) Testing of the working range of the GMR sensor
(b) GMR sensors circuit in a Wheatstone Bridge

RESULT AND DISCUSSION

Test results GMR sensor response to the distance to the source of the magnetic field is shown in Figure 3. Actually, the GMR sensor only responds by changes in the magnetic field generated by the permanent magnet and the sensor does not respond to the magnetic position. However the value of the magnetic field influenced by the distance of the magnetic source. The farther away from the source of the magnet has a magnetic field is getting smaller. Thus indirectly also sense GMR sensor distance to the magnetic source. Therefore, it can be stated GMR sensor output voltage relationship to distance. Based on the graph V_{GMR} versus distance r from figure 3 can be determined the range of performance as follows:

At the X direction:

- Saturation in the range of 0 up to 5cm
- The range of measurement: between 5- 18 cm.
- Regions Cut-Off (no response from the sensor): more than 18 cm

At the Y direction:

- Saturation in the range of 0 up to 6cm
- The range of measurement: between 6-22 cm.
- Regions Cut-off (no response from the sensor): more than 22 cm

Tests were performed using two-way coordinate axes, namely the X axis and Y axis. GMR sensor range test results on the X-axis direction has a saturation 258,2mV at a distance of 5cm and cut off at a distance of 18 cm 6,8mV on. Testing the GMR sensor range on the Y-axis direction has saturation 260,1mV at a distance of 6cm and cut off at 17mV at a distance of 22 cm. After knowing the working range of the GMR sensor can be used to perform measurements of the concentration of ferric Chloride.

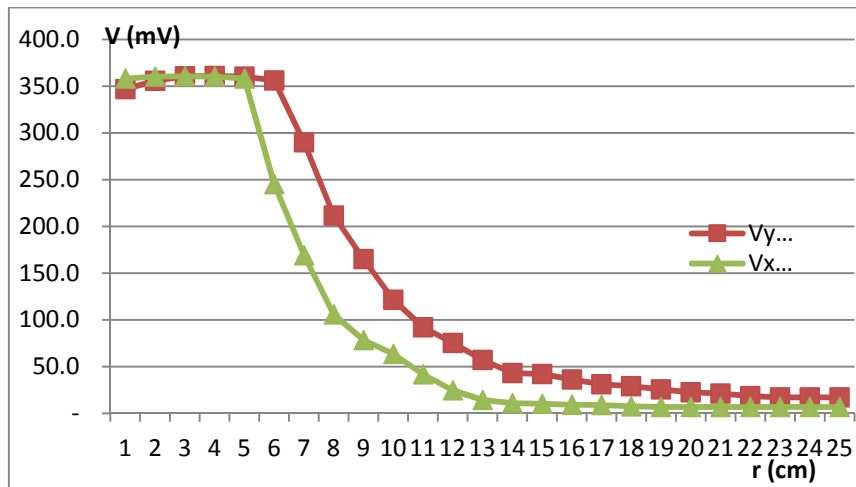


Figure 3. Graph Voltage of GMR sensor (V) versus position (r)

CONCLUSION AND SUGESION

The performance range of the measurement system ferric chlorit concentration determined by performance range of the GMR sensor. GMR sensor sense magnetic field which has been designed as object disturbance. Sources of magnetic field generates field strength of 0.97 Tesla. Methods of testing done by putting the GMR sensor at a distance of 0 to 24 cm of the magnetic field source with variations 1cm. Range limits determined by the state of saturation of the sensor as the upper limit and the state cut off as the lower limit. Tests were performed using two-way coordinate axes, namely the X axis and Y axis. GMR sensor range test results on the X-axis direction has a saturation 258,2mV at a distance of 5cm and cut off at a distance of 18 cm 6,8mV on. Testing the GMR sensor range on the Y-axis direction has saturation 260,1mV at a distance of 6cm and cut off at 17mV at a distance of 22 cm. This research can be developed to measure position of an object in two-dimensional or three-dimensional.

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