RESEARCH, MANUFACTURING OPTIMAL STRUCTURE SENSOR MEASURE THE LOW MAGNETIC FIELD STRUCTURE WHEASTONE BRIDGE BASED ON ANISOTROPIC MAGNETORESISTANCE EFFECTS

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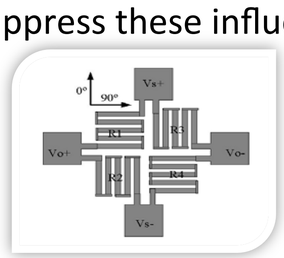
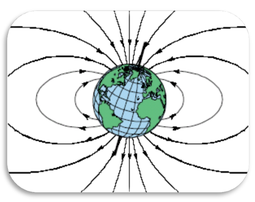
WHEASTONE BRIDGE SENSOR

INTRODUCTION

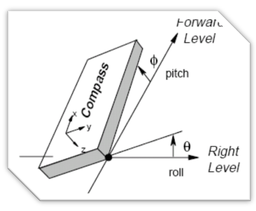
The Magneto-resistive sensors is realized in known manner in the form of Wheatstone bridges in order to minimize the influence by ambience on the measuring signal, such as changes in temperature, or to entirely suppress these influences



Scheme of the use of a Wheatstone bridge in a magnetic sensors.



Earth's Magnetic Field Dipole Model

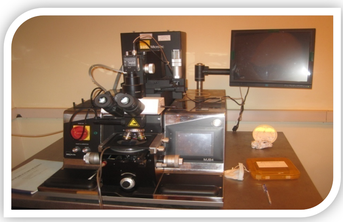


Compass Tilt Referenced To The Earth's Horizontal Plane

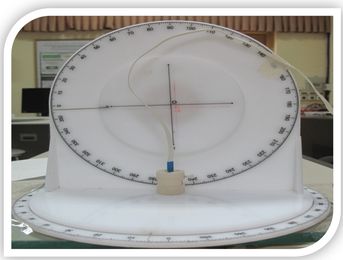
EXPERIMENTS

1. **The DC magnetron sputtering system Model ATC-2000FC**

2. **The Wheastone bridge sensors were structured by using photolithography technique (Model MJB4)**

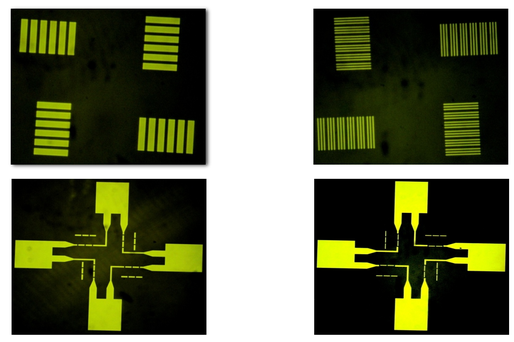


3. **Shematic of wheatstone bridges measurement**



WHEASTONE BRIDGE SENSOR

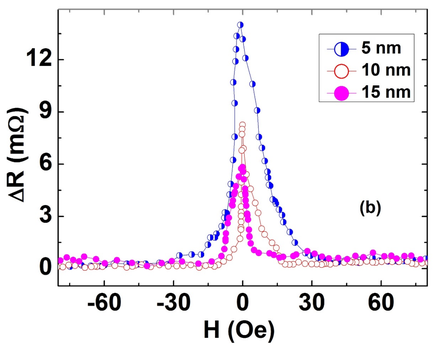
1. **The mask design for patterned sensors**



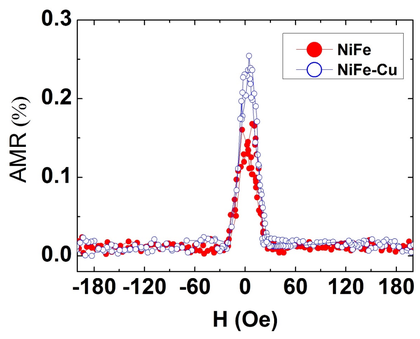
2. **Micrograph of the single Wheastone Bridge sensor**

The Left: size of 50×250 μm. The Right: size of 10×50 μm

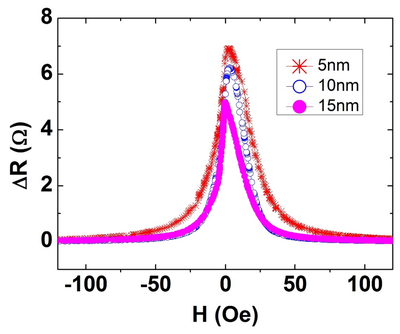
RESULTS AND DISCUSSION



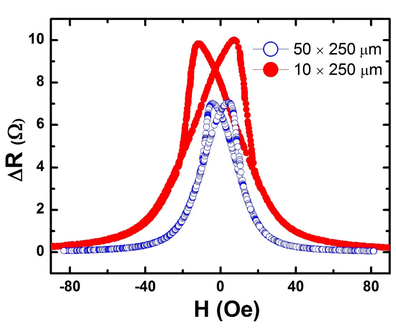
Resistance changes as a function of magnetic DC of NiFe thin films (5, 10, 15 nm): ΔR_{max} = 14 mΩ (5 nm), ΔR_{min} = 5.8 mΩ (15 nm)



AMR signal in NiFe and NiFe-Cu branch bridges: The *AMR* ratios were recorded to be 0.27% (Cu), and 0.17% (NiFe)



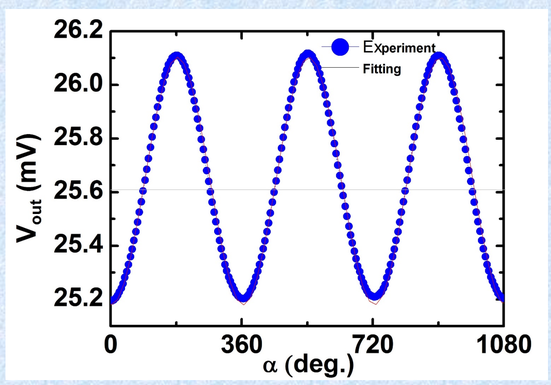
Resistance changes versus magnetic DC: 50×250 µm and different thickness: ΔR_{max} = 7 Ω, $S_H = \Delta R/H$ = 0,88 Ω/Oe (5 nm), and ΔR_{min} = 5Ω, S_H = 0,49 Ω/Oe (15 nm)



Resistance changes versus magnetic DC of sensor with sizes of 10×250 µm and 10×250 µm, thickness of 5 nm: Sensor size 10×250µm, thickness 5nm, max signal ΔR = 10 Ω, sensitivity S_H = 0,88 Ω/Oe.

Geomagnetic field

Geomagnetic field



The sensor with size of 10×250 µm was then selected to examine the Earth's magnetic field. Results of the output voltage depends on α-angle between the sensor's longitudinal axis and the Earth's North magnetic Pole in three period: $V = V_{offset} + V_{max}.cos\alpha$ (mV) in which V_{offset} = 25,64 mV and V_{max} = 0,462 mV (I_{in} = 5 mA). The sensitivity S_α was estimated to be 8,8 (µV/deg.).

CONCLUSION

- The Sensor size 10×250µm, thickness 5nm, max signal ΔR = 10 Ω, sensitivity S_H = 0,88 Ω/Oe.
- Results of the output voltage depends on α-angle between the sensor's longitudinal axis and the Earth's North magnetic Pole in three period: $V = V_{offset} + V_{max}.cos\alpha$ (mV) in which V_{offset} = 25,64 mV and V_{max} = 0,462 mV (I_{in} = 5 mA). The sensitivity S_α was estimated to be 8,8 (µV/deg.).
- The sensor can detect precisely not only the strength, but also the orientation of the Earth's magnetic field

References

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