Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Chemistry

Elixir Appl. Chem. 91 (2016) 38620-38622

ISSN: 2229-712X

The effect of Beta-radiation and magnetic field intensity on Ni-Cr alloy properties

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ARTICLE INFO

Article history:

Received: 15 April 2012;

Received in revised form:

23 February 2016;

Accepted: 27 February 2016;

Keywords

Ni-Cr alloy,

Magnetic field,

Radiation,

Alloy properties.

ABSTRACT

An experimental investigation of applying a magnetic field and a radiation source horizontally with the direction of alloy once and vertically in another, current range passing through alloy is (1-3) AMP. When a magnetic field applied vertically with the direction of alloy, the resistance is higher than in case of applying it horizontally. The increase in radiation time will increase the alloy resistance. The increase of resistance will increase temperature in case of applying the magnetic field in vertical direction. The increase in resistance, the temperature approximately satiable.

Introduction

The physical properties, such as density, reactivity, Young's modulus, and electrical and thermal conductivity, of an alloy may not differ greatly from those of its elements, but engineering properties such as tensile strength [Adelbert ,1922] and shear strength may be substantially different from those of the constituent materials. This is sometimes due to the sizes of the atoms in the alloy, since larger atoms exert a compressive force on neighboring atoms, and smaller atoms exert a tensile force on their neighbors, helping the alloy resist deformation. Sometimes alloys may exhibit marked differences in behavior even when small amounts of one element occur [Hogan-1962, Zhang-1985].

The term alloy is used to describe a mixture of atoms in which the primary constituent is a metal. The primary metal is called the base or the matrix. If there is a mixture of only two types of atoms, not counting impurities, such as a copper-nickel alloy, then it is called a binary alloy. If there are three different types of atoms forming the mixture, such as iron, nickel and chromium, then it is called a ternary alloy. An alloy with four constituents is a quaternary alloy, while a five-part alloy is termed a quandary alloy. Since the percentage of each constituent can be varied, with any mixture the entire range of possible variations is called a system [Michael, 2005].

Experimental Part

The material that used in this work is $Ni^{70\%}$-$Cr^{30\%}$ alloy wired as coil of 10cm length and three coils. The resistivity was measured using Keithly electrometer.

The electrical conductivity σ_v was calculated by:

$$\sigma_v = \frac{1}{\rho_v} = \frac{L}{RA} \quad \text{.....(1)}$$

Where:

A = cross-sectional area (cm^2)

R = volume resistance (Ohm) .

L = wire length (cm) .

The source of radiation was Beta with activity of 4.5μCi, current range passing through alloy is (1-3) AMP.A digital thermometer was used as temperature measurement.

Results and discussions

Fig.(1)shows the relationship between magnetic field strength and resistance of Ni-Cr alloy, it shows that the increase in magnetic field strength will cause a little increase in resistance in the case of magnetic field only, but will cause a sharp increase in the case of founding magnetic field and radiation together, and we saw that when a magnetic field applied vertically with the direction of alloy, the resistance be higher than in case of applying it horizontally, that is due to the magnetic field direction in line with the flow of free electrons.that is lead to reduce the resistance.

Fig.(2) shows the variation of resistance of Ni-Cr alloy with radiation time in the presence of magnetic field in horizontal in once and vertical Direction in another. The increase in radiation time will increase the resistance. when a radiation source and the magnetic field applied together vertically with the direction of electrons movement in the alloy, the temperature approximately satiable, while in the case of the horizontal its increased significantly , that's due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance.

Fig.(3)variation of resistance of Ni-Cr alloy with radiation time in vertical exposure in once and horizontal in another. The increase in radiation time will increase the resistance, the temperature approximately satiable, while in the case of the horizontal it's increased significantly that's due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance.

Fig.(4) shows the increase of resistance will increase temperature in case of applying the magnetic field in vertical direction. The increase in resistance, the temperature approximately satiable.

Fig.(5) shows the increase of resistance will increase temperature in case of applying the radiation in vertical

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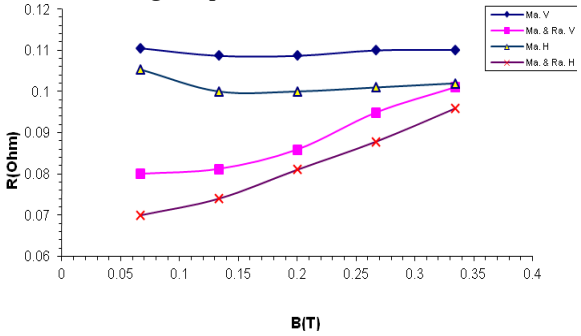
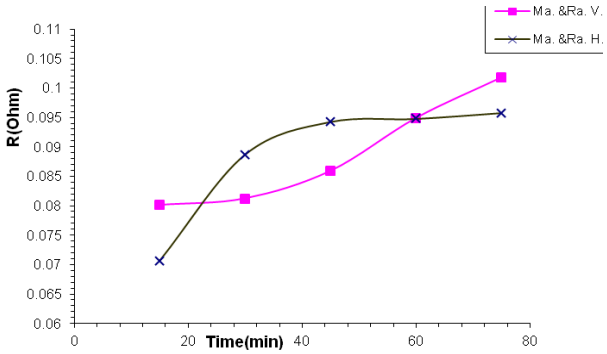
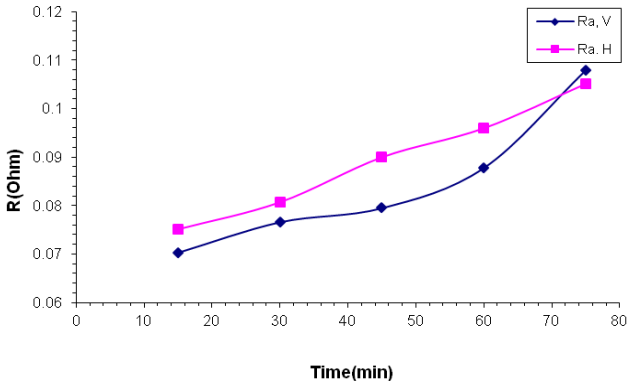
direction, due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance. Therefore increasing temperature.



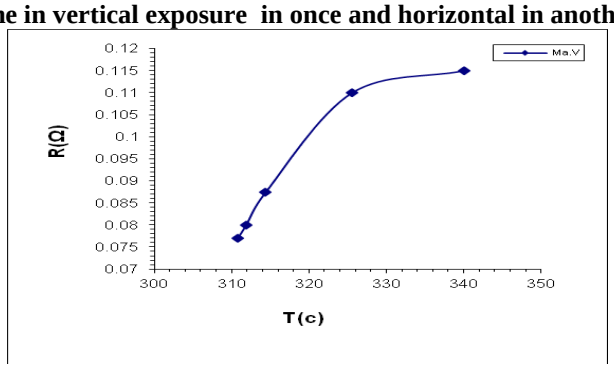
Fig(1) variation of resistance of Ni-Cr alloy with magnetic field strength in horizontal and vertical Direction with radiation in once and without radiation in another.



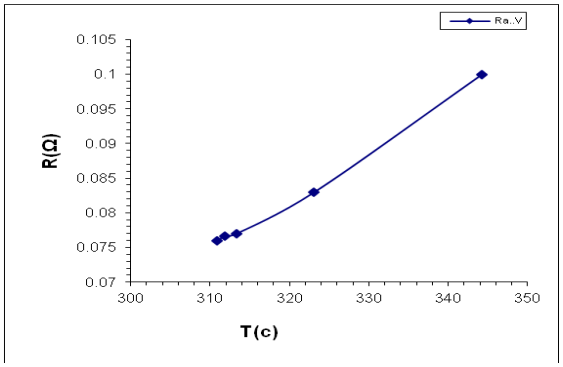
Fig(2) variation of resistance of Ni-Cr alloy with radiation time in the presence of magnetic field in horizontal in once and vertical Direction in another.



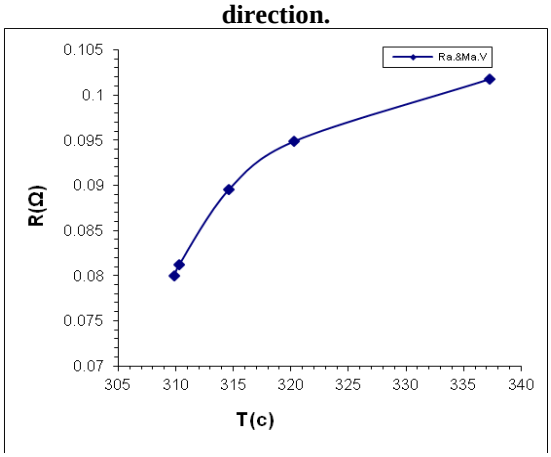
Fig(3) variation of resistance of Ni-Cr alloy with radiation time in vertical exposure in once and horizontal in another.



Fig(4) variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field in vertical direction.

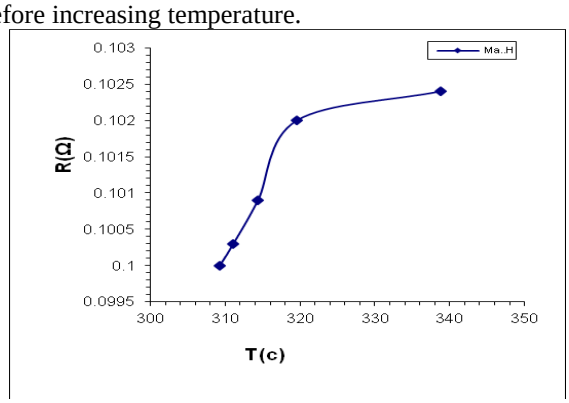


Fig(5) variation of resistance of Ni-Cr alloy with temperature in the presence of radiation in vertical direction.



Fig(6) variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field and radiation in vertical direction.

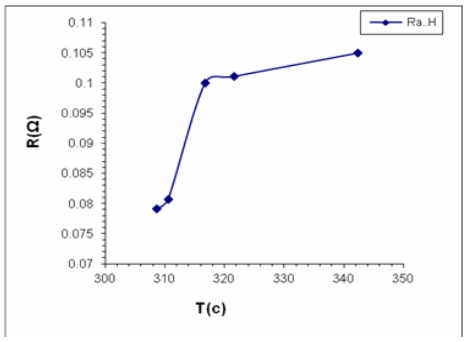
Fig.(6) variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field and radiation in vertical direction, the increase in resistance will increase the temperature, due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance, Therefore increasing temperature.



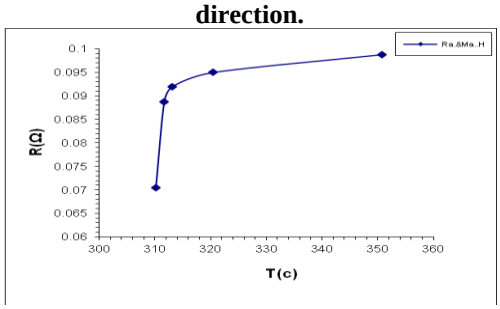
Fig(7) variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field in horizontal direction.

Fig.(7)shows variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field in horizontal direction, the increase in resistance will increase the temperature,

Fig.(8) shows variation of resistance of Ni-Cr alloy with temperature in the presence of radiation in horizontal direction, the increase in resistance will increase the temperature, due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance, Therefore increasing temperature.



Fig(8) variation of resistance of Ni-Cr alloy with temperature in the presence of radiation in horizontal direction.



Fig(9) variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field and radiation in horizontal direction

Fig.(9)shows variation of resistance of Ni-Cr alloy with temperature in the presence of magnetic field and radiation in horizontal direction, the increase in resistance will increase the temperature, due to collisions between the beta particles and electrons in the alloy, which leads to increased resistance, Therefore increasing temperature.

Conclusions

From the present work, we can write the following conclusions:

1. When a magnetic field applied vertically with the direction of alloy, the resistance be higher than in case of applying it horizontally.
2. The increase in radiation time will increase the resistance.
3. The increase of alloy resistance will increase temperature.

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