Synthesis and processing of magnets and the Curie temperature dependence on composition of the material

Socaciu-Lendvai Márk[1], Kovács Róbert-Jenő[1], Szabó Gergely-Sándor[1]
Supervisor: Popa Márta[1], Dr. Popa Florin[2]
[1]János Zsigmond Unitarian High School, 400105 Cluj-Napoca, 21 Decembrie no.9, Cluj County
[2]Technical University of Cluj-Napoca 400641 Cluj-Napoca, Bd. Muncii no.103-105, Cluj County

1. Introduction

Magnets surround us, like in our phones, any generator: hydroelectric power plant, wind power plant, cars' alternator or the simple dynamo. They are everywhere and can be used in many domains, such as electronics, heavy industries, health and research also. These beautiful things are very helpful, but the majority of us do not know from what they are made and how they work. Nowadays engineers and the researchers are occupied with the temperature superconductors and their use in space research.

AIM: The aim of this research is the presentation of the synthesis of the magnets and the measurement of their specific characteristics for getting a better thermal resistance and a stronger magnetic material.

2. Experimental Setup

In our experiment we used powder of neodymium, iron and boron, elements from which the most powerful magnets at the current time are made, Ni_3Fe for its good ferromagnetic characteristics in transmission of the magnetic flux and araldite, a polymer as a connecting element in the composition. We homogenized the powders and included different amounts of polymer into it then magnetized the samples and measured the specific characteristics using the **Permagraph** and **Remacomp** systems. For the measurement of the Curie temperature (where the magnet loses the organized form of the magnetic moments) we built a system (Fig. 1) which consists of a thermometer, an alternative electric power source, a voltmeter and a coil, all of these connected to a computer, which oversees the whole experiment and registers the results.

Fig.1 Curie temperature determination

We studied the influence of the ratio between the nonmagnetic and magnetic components on the characteristics of the magnet for hard and soft magnetic materials, which we synthetized.

3. Results

Results show (Fig.2) that both the strength of the magnet and its energy also decreases with araldite content (the content of the nonmagnetic part).

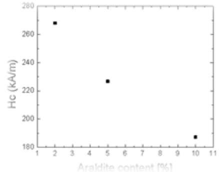

Fig.2 Evolution of the strength of the magnet with the araldite percent

Figure 3 shows the evolution of the Curie temperature of alloys with different ratio between the magnetic and nonmagnetic component (Ni-Cu alloy).

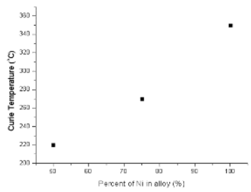

Fig.3 Curie Temperature evolution with the nonmagnetic material's content in alloy

The soft magnetic materials (Ni_3Fe) were tested for different frequencies of alternative current and were measured the losses (Fig.4). As the frequency increases, the losses increase and the efficiency of the material decreases.

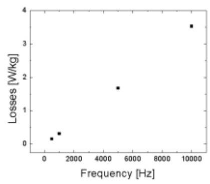

Fig.4 Evolution of losses with increasing frequency

4. Conclusions

At hard magnetic materials the coercive field and the energy of magnet decreases as the araldite content increases.

At soft magnetic materials the losses increase with increasing frequency for all compositions and the properties are constant up to 5 % araldite and decrease at 10 % araldite.

As the nonmagnetic component increases in the alloy, the Curie temperature decreases.