

Special Issue “Advances in Magnetic Alloys”

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Magnetic alloys are a combination of different metals that contains, but are not limited to, at least one of the three main magnetic elements: iron (Fe), nickel (Ni), or cobalt (Co). The strongest magnetic element is iron, which allows items made out of iron alloys to be attracted to magnets. Magnetic alloys have become common in our everyday life, especially in the form of steel (containing iron and carbon), alnico (containing iron, nickel, cobalt, and aluminum), permalloy (iron and nickel), ferrites (like MeOAl_2O_3 or $\text{A}_3\text{B}_5\text{O}_{12}$ where cation Me could be Mn, Fe, Co, Ni, or Zn in spinel ferrites or Ba, Sr, or Pb in hexagonal ferrites), or special materials with rare earth elements.

Magnetic alloys can be divided into two main categories based on magnetization type:

- (1) Soft magnetic materials—characterized by a very narrow hysteresis cycle (high magnetic permeability and coercivity below about 10^3 A m^{-1}) and, therefore, they can be easily magnetized, even in weak magnetic fields.
- (2) Hard magnetic materials—characterized by a wide hysteresis cycle (coercivity above about 10^4 A m^{-1}), high remanence, and high energy (maximum volume of energy density that the magnet can provide externally as an independent source).

There is another more recently defined class of magnetic materials, called semi-hard magnetic materials, dedicated to magnetic recording media. The hysteresis cycle of these materials is quite wide, but slightly narrower than that of permanent magnets.

The soft magnetic materials can be used in direct current (DC) and alternating current (AC) applications. In DC soft magnetic applications, the magnetic material is magnetized in order to perform a specific task and then demagnetized at the end of that operation, i.e., switchable electromagnets. In AC applications, the soft magnetic material will be continuously cycled, often at rather high frequencies (e.g., a power supply transformer). A high magnetically permeability will be desirable for applications at high frequencies.

Magnetically hard materials, like steel and special alloys, can be permanently magnetized by a strong magnetic field.

Based on international classification standards, hard magnetic materials can be divided into hard magnetic alloy materials (alloys based on AlNiCoTi , FeCr , RE-CoFe , CuNiFe , etc.), hard magnetic ceramic materials (PZT, perovskites, etc.) and bonded hard magnetic materials (NiCrFeTi , NdFeB , ferrites, etc.).

Multifunctional materials based on such magnetic alloys have various shapes and sizes such as (nano)particles, (micro)wires and nanowires, ribbons, powders, thin films, bulk materials, etc., and with various structures and characteristics, e.g., amorphous, nanostructured, magnetostrictive, etc. The development of such novel multifunctional materials requires the study of their properties and structures in order to be considered potential candidates in the development of novel applications [1–4]. Their special properties can support the manifestation of a significant number of specific phenomena and effects, and therefore they can be used as the sensing elements in various sensing devices for multiple applications (e.g., automotive, medical, and electromagnetic devices with technical applications in various civil and military fields, etc.).



Citation: Ababei, G. Special Issue “Advances in Magnetic Alloys”.

Metals **2023**, *13*, 1723. <https://doi.org/10.3390/met13101723>

Received: 11 September 2023

Accepted: 19 September 2023

Published: 10 October 2023



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This Special Issue “Advances in Magnetic Alloys of Metals” (ISSN 2075-4701), an international, open access metallurgy journal published monthly online by MDPI, publishes new and original research papers in the field of magnetic alloys. This Special Issue focuses on transition and rare metal extraction, purification, deformation, physical and mechanical behaviors, characterization, shaping, modeling, materials design, and medium- and high-entropy alloys.

Conflicts of Interest: The author declares no conflict of interest.

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