Research on the Development of New Technologies Based on New Magnetic Material Technology Entrepreneurship

Wei Wei¹⁺, Jing Zhang²⁺
¹Entrepreneurship Guidance Center, Tianjin University Renai College, Tianjin, China
²School of Mechanical, Tianjin University Renai College, Tianjin, China

*Corresponding author e-mail: xws2005@126.com, tdwwwip@126.com

Abstract. New materials, especially those related to magnetic materials, face the contradiction between the company's own scale and central tasks. It is necessary to formulate reasonable product research and development measures and overall corporate strategy to ensure that enterprises can smoothly pass this high risk and high. The period of growth. Based on the main business of magnetic materials companies and the related characteristics of magnetic materials, this paper analyses the special characteristics of the new magnetic materials enterprises in the entrepreneurial stage, and at the same time formulates the overall strategy and functional strategies of the entrepreneurial stage according to the development of the enterprise to help the new innovative magnetic materials. The company smoothly passed the stage of entrepreneurial development.

1. Introduction
After nearly half a century of development of magnetic materials, the basic theory is quite mature. It is still relatively easy to produce high-performance magnetic materials in the laboratory. However, for large-scale production enterprises, the scientific and rational manufacture of magnetic materials it will bring many difficulties in product quality management to the manufacturer. The whole process from material preparation, core processing to packaging and shipping has a certain impact on product quality. In view of the rapid development of electronic information industry, some quality Benefit-oriented enterprises have turned into the magnetic materials industry. While enhancing the strength of China's magnetic materials, the cruelty of competition has also intensified. Grouping, scale, and re-combination have become the development trend of the industry. Objectively speaking, who can get the quality up, the cost down, who is the winner, this also puts new requirements for the quality management of magnetic materials companies [1].

In order to improve the overall innovation strength of the manufacturing industry, the state's emphasis on core basic industries has reached an unprecedented new height. The Ministry of Industry and Information Technology has issued major support projects such as strong foundation projects. The state and local governments have also introduced a series of science and technology policies and rewards and measures to support and promote manufacturing from various angles such as policy support, tax incentives, innovation atmosphere, talent cultivation and international cooperation. Upgrade transformation. Promote industrialization and information integration initiatives, and achieve new breakthroughs in national economy and informationization such as R&D and design informationization, production and manufacturing intelligence, comprehensive support network, and social management.
and service innovation. At the same time, we will vigorously implement the innovation-driven and "Made in China 2025" strategy, and accelerate the development of "new generation information technology, high-end equipment, new materials, biology, new energy vehicles, new energy, energy conservation and environmental protection" and other strategic emerging industries. Direction. More than 80% of the key industry sectors are closely related to the magnetic materials industry, which brings great opportunities for the re-explosion and development of the magnetic materials industry [2].

2. Correlation characteristics and magnetic field mechanical expression of magnetic materials

2.1. Magnetic field mechanics expression

Simplified excitation model, magnetic field force volume density of linear, isotropic ferromagnetic media is:

\[ \vec{f} = \vec{J} \times \vec{B} - \frac{1}{2} \mu H^2 \nabla \mu + \frac{1}{2} \nabla \left( H^2 \tau \frac{\partial \mu}{\partial \tau} \right) \]

Where: \( \vec{f} \) represents the magnetic force volume density vector; \( \vec{J} \) represents the current density vector; \( \vec{B} \) represents the magnetic induction vector; \( H \) represents the magnetic field strength; \( \mu \) represents the permeability of the medium; \( \tau \) represents the bulk density of the medium.

The first item in the formula is Lorentz's force, and the third item is used to characterize magnetostriction. For linear, isotropic ferromagnetic media, the permeability of the medium can be...
considered to be related only to its bulk density. The magnetic force in the formula (1) is a vector form, which is decomposed into three components along the Cartesian coordinates, which can be derived by:

\[
\begin{align*}
fx &= \frac{\partial}{\partial x} \left[ \mu H_x^2 - \frac{H_z^2}{2} \left( \mu - \tau \frac{\partial \mu}{\partial \tau} \right) \right] + \frac{\partial}{\partial y} \left( \mu H_y \right) + \frac{\partial}{\partial z} \left( \mu H_z \right) \\
fy &= \frac{\partial}{\partial x} \left( \mu H_x H_y \right) + \frac{\partial}{\partial y} \left[ \mu H_y^2 - \frac{H_z^2}{2} \left( \mu - \tau \frac{\partial \mu}{\partial \tau} \right) \right] + \frac{\partial}{\partial z} \left( \mu H_z \right) \\
fz &= \frac{\partial}{\partial x} \left( \mu H_x H_z \right) + \frac{\partial}{\partial y} \left( \mu H_y H_z \right) + \frac{\partial}{\partial z} \left[ \mu H_z^2 - \frac{H_z^2}{2} \left( \mu - \tau \frac{\partial \mu}{\partial \tau} \right) \right]
\end{align*}
\] (2)

2.2. Magnetic material characteristics expression

It is well known that the magnetic properties of magnetic materials are intrinsic magnetic properties and technical magnetic properties. The internal neodymium magnetism includes Curie temperature, saturation magnetization, magneto crystalline anisotropy, etc., which correspond to the magnetic properties, spin magnetic moment, crystal field and other intrinsic properties, mainly due to the crystal structure, magnetic structure, composition, etc. of the material. Decide. The magnetic structure is closely related to the crystal structure of the material, and its symmetry can be the same as that of the crystal structure, but in most cases, magnetic ordering adds new magnetic symmetry. The magnetic structure is determined by the crystal structure as well as the magnetic interaction and the spin magnetic moment. Ferromagnetic, antiferromagnetic, ferromagnetic, spiral magnetic, spin glass, paramagnetic and other different magnetic and different crystal structures can be combined into a colorful magnetic structure. On the other hand, technical magnetic properties include residual magnetization, coercivity, maximum magnetic energy product, temperature coefficient, and the like. The magnetic properties of these technologies are not only controlled by the intrinsic magnetic properties of the material, but also closely related to the microstructure of the material. In fact, the size, shape, grain size, grain boundaries, defects, and second equality of the material all affect the magnetic properties of the material.

2.2.1. Size effect. The quantum dot size affects the size of the antiferromagnetic domain and weakens the intensity of the magnetization reversal of the antiferromagnetic phase pinning ferromagnetic phase; the fine magnetic structure of the antiferromagnetic layer in the ferromagnetic/antiferromagnetic bilayer determines the ferromagnetic layer Magnetic domain structure; the size of the domains in the film and the width of the strip domains vary with the square root of the film thickness; the magnetic properties of the anti-lattice film are different from the continuous film of the same composition; the magnetic domain structure and magnetization reversal of the nanowires The width of the nanowire is related; the shape of the polygonal element affects the formation of the vortex state and the edge defect causes the magnetization to be reversed by the vortex mechanism; the shape of the lattice regulates the frequency of the resonant excitation of the vortex state.

Reference [3] reports the reverse phase transition effect of a higher symmetry phase in the sample at the surface of the vertical iron film in the direction of magnetization than at high temperatures. The magnetization directions of these films are not uniform, but form strip domains that are inversely perpendicularly magnetized. From scanning electron microscopy imaging, Portman et al. found that when the temperature rises, the fringe domain structure at low temperatures transforms into a labyrinth structure with higher symmetry. However, at higher temperatures but before the magnetic order disappears, the low symmetrical fringe domain structure reappears. This is the first report of this phase change sequence and the microscopic instability that drives it. Figure 2 shows that the magnetic domain structure on the surface of the iron film varies with thickness and the law of temperature change, so the size effect of the iron film can be regarded as the effective temperature.
Figure 2. The magnetic domain structure on the surface of the iron film changes with thickness and the law of temperature changes.

Reference [4] directly observes the non-traditional topological spin states and their behavior in antiferromagnetic ally coupled NiFe disks at room temperature. Figure 3 is a micro-magnetic simulation study of the Lorentz microscope observation of the wheat-like state in NiFe/Cr/NiFe disks. The observed spin structure is similar to the theoretically predicted structure of the maiden (first experimental report). The stability and behavior of the wheat state were studied by Lorentz microscope in situ magnetization experiment combined with micro magnetic simulation.

Figure 3. Lorentz Microscope Observation of Micro-Magnetic Simulation in the NiFe/Cr/NiFe Disk.

2.2.2. Defects in magnetic materials. Nano-scale magnetic domains in magnetic ultra-high-density storage media have their spins reversed under thermal perturbations, which causes data bits stored in the magnetic media to be lost due to instability. Studies have shown that magnetic media having a direction of magnetization perpendicular to the surface of the film, such as ultra-thin cobalt films or multilayer film structures, have the ability to resist thermal perturbations and loss of stored information over
conventional magnetic storage media. The roughness and mobility of magnetic domains can impede tighter compression storage of magnetic data bits, which is a huge challenge for achieving higher density data storage. Literature [6] found that the strain caused by the line defects of the magnetic film not only smoothed the rough magnetic domain in the range of several hundred micrometers, but also effectively suppressed the movement of the magnetic domain wall. Using the disordered regulation elastic line theory, the physical mechanism of the above discovery was scaled and studied, and then an experimental scheme for achieving 1T/square foot ultra-high magnetic media storage was proposed.

The spiral spin-sequence structure in magnetic materials has been observed only in the reciprocal space. Literature [7] used Lorentz electron microscope imaging technology to observe the spiral spin-sequence structure and its dynamic characteristics in metal silicide in real space. The spiral spin-sequence structure in real space is richer than the average structure theory prediction, and it exhibits a series of magnetic defects similar to atomic dislocations in the lattice. Under the action of the magnetic field, the deformation process of the spiral spin-sequence structure is directly observed, accompanied by the generation, movement and quenching of the magnetic defect.

3. Magnetic materials companies need to pay attention to the entrepreneurial stage

3.1. Deep technological innovation
In order to improve quality, we must align our products with the best products on the market, pay attention to the formulation of product quality planning and procedures, establish a sound quality and production management system, and focus on design, process control and quality services for total quality management. In addition to these three links, we must pay great attention to the pre-design market survey, and effectively understand the specific requirements of customers for product quality and the quality level that similar products in the market have achieved. In the work practice combined with the development of the magnetic material market, we must clearly understand that enterprises must form their own technological characteristics and product chains that meet the needs of the market, and take the road of science and technology to strengthen the enterprise, in order to be based on the market; Firmly establish the awareness of "innovation, not innovation, and death" to enhance the sense of crisis and responsibility. As the quality certification work is continuously implemented in the enterprise, it is emphasized that we must pay attention to the principle of "customer-centered". When formulating product quality standards, we should fully understand the customers’ thinking and the urgency of the customers. And summed up the opinions of many customers, and taking into account the technical effects of different products, and finally formed a customer-oriented internal control standard.

3.2. Brand building
In order to ensure that enterprises maintain long-term development in a cruel competitive environment, strategic planning must be carried out, and brand building becomes more and more important. Brand is an effective way to establish corporate image, representing the popularity of products in the market, the reputation and credibility of customers, and the guarantee of quality service to customers. In a sense, brands are enterprises. An invisible means of competition for sustainable development. To create a good brand image, the core is to make the product itself establish relationships with customers, and to build and improve product quality standards. It is the most direct and effective means for many companies to seek sustainable development under increasingly volatile market conditions.

3.3. Strict production management
Strict production management should be a long-term strategic work of the company. While the production system forms a good quality management system, it is necessary to implement the relevant elements of the ISO9000 quality standard to each responsible contact point, formulate corresponding management standards and operational specifications, establish a mechanism to do things according to standards and continuously improve the mechanism. The quality management work is cut into the specific links with the content of "quality assurance". Taking the control points of production process
of Mn-Zn ferrite material as a case study, how the magnetic material enterprises in the production process can achieve the quality and quantity of the startup stage through production process control [5].

4. Key steps of production and quality control of MnZn ferrite magnetic materials

4.1. Original cooking analysis
Since there are many manufacturers of ferrite raw materials, the purity, impurity, and activity of different batches of raw materials of various manufacturers and even one manufacturer are not the same. Therefore, accurate physical and chemical analysis should be carried out before use. The analysis of purity and impurity content is the most important. Inaccurate purity, the formula will deviate, the consequences are naturally self-evident. The accurate determination of the impurity content has a guiding effect on the subsequent process. For the power ferrite, in order to reduce the eddy current loss, an appropriate amount of impurities such as SiO2 and CaCO3 are generally added to form a CaSiO3 high-resistivity layer at the grain boundary during the sintering process. If the raw material has a high content of these impurities, it may be added or not added in the subsequent doping. At the same time, raw materials with high impurity content cannot be used for the production of high magnetic permeability core. Otherwise, abnormal grain growth will occur under high temperature sintering, and the magnetic properties of the product will be greatly reduced.

4.2. One sanding
One sanding is also called mixing, and the purpose is to thoroughly mix the three raw materials. The sanding time should not be too long, and the mixing can be uniform to avoid the agglomeration of ZnO.

4.3. Pre-burning
Pre-sintering refers to pre-sintering a uniformly mixed dry powder, which functions to control the shrinkage of the product and reduce the deformation of the product. The higher the frequency of use, the higher the calcination temperature. The better the activity of the raw materials, the higher the calcination temperature, and the holding time is generally 2~4h.

4.4. Secondary sanding
The dispersing agent used in the production of relatively high-grade manganese-zinc ferrite in secondary sanding is generally deionized water. Some manufacturers also use tap water in their production, but they usually use river water instead of well water because of the low impurity content of the river water and the high amount of well water. The manganese-zinc ferrite pre-sintered material is doped with impurities before secondary sanding to improve its magnetic properties. The production of high magnetic permeability products, can be mixed with TiO2, ZrO2 and combined with the sintering process to promote uniform growth of the grains without excessive, thereby improving the Q value under weak field and reducing the loss.

4.5. Granulation

4.5.1. Preparation of spray slurry
(1) Within the last ten minutes of the secondary sanding, the slurry was taken three times from the exit of the sanding and the density was measured. The average of the three measurements was calculated as the density of the original slurry, and \( d_L = 1.34 \pm 0.1 \text{ g/cm}^3 \) was acceptable.

(2) The weight of the added adhesive (adhesive) is 10% by weight of the dry powder in the original slurry. In the first step, the density of the original slurry has been measured. As long as the volume \( V \) and the solid content \( Q \) of the slurry drawn into the mixing tank are measured, the dry powder weight in the slurry is measured.

\[
W = V d_L Q
\]
Wherein, the volume \( V \) is calculated by measuring the depth of the slurry in the mixing drum and the inner diameter of the mixing barrel; the solid content is first weighed and then dried after the second five minutes of the secondary sanding. Get.

(3) After adding the glue, it should be stirred rapidly for more than 6 hours. Add self-looping and filtering in this process. Because the glue is not easy to coat evenly on the sanded powder, if the rapid stirring time is not enough, the grape bunch particles will be produced instead of the single particles during granulation; if it is not self-circulating and filtered, it will be dispersed. The hard slag produced by the agent A15 clogs the nozzle during spray granulation. In short, if the stirring time is not enough, the PVA of the binder will be unevenly distributed in the slurry, and some of the particles with a large PVA content are difficult to be formed due to large friction during the molding process; the slurry having a small PVA content is easy to be formed after granulation, but The strength of the blank is low, and the blank is easily damaged during handling, swaying, and the like.

4.5.2. Granulation

(1) The spray granulation tower should minimize the amount of air leakage during the work process. If there is a leak in the discharge port, the gun insertion port and the powder collection, the negative pressure will be reduced and even a positive pressure will be generated. At this time, the hot air in the tower body is unevenly cooled during the downward flow, resulting in uneven water content of the particles and a large water content, and the produced pellets have a large water content, and a sticking mold occurs during the molding process, layer cracking phenomenon.

(2) Reasons for the spray tower to produce large wet cakes. The nozzle itself is not well sealed. If the nozzle and the gun are not sealed, the slurry will flow out from the gap and accumulate in the cone of the tower. After a period of time, the contact surface between the cake and the tower is dried. The whole block fell.

(3) Reasons for the formation of spherical granules. Reason one: Partially block the spray gun or block the nozzle. In the granulation process, the relative motion of the slurry particles and the hot air is first countercurrent (reverse direction), followed by concurrent (same direction). If in the previous stage, the slurry in the spray gun or nozzle dries and agglomerates, the injection pressure of the nozzle hole is lowered and the pressure on the pressure gauge of the pressure tank is constant or increased, and the amplitude of the pointer is reduced. The particles are coarse, and some of them fall on the spray gun system and the lower part of the tower body, and gradually dry and form a tower. Reason 2: The PVA content is too large, and the slurry is not completely split during the spraying process. If the splitting is not complete, several or more spherical particles will stick out together at the discharge port. At this time, although the bulk density is large and the fine powder content is small, the surface of the powder particles is rough and the molding is difficult.

4.6. Forming

Attention should be paid to the water content and fluidity of the powder during the molding process. The powder with a large water content is prone to delamination and sticking after molding. At this time, the material should be properly dried to reduce the water content, and it is formed. The poor fluidity of the powder also causes difficulty in forming. Especially in the case of forming a blank having a complicated shape, the compaction density of the green body is often uneven due to the poor fluidity of the powder, and the product is severely deformed after sintering. An appropriate amount of zinc stearate can be added to the powder to improve its fluidity.
Figure 4. Magnetic domain structure of Nd-Fe-B anisotropic permanent magnet film after annealing.

5. Conclusion
In the stage of entrepreneurship, new magnetic materials enterprises must adhere to strengthening industrial basic capabilities, improve the level of comprehensive integration, improve the multi-level and multi-type talent training system, and promote industrial transformation and upgrading. The magnetic material manufacturing industry is stronger and bigger, it is closely following the national innovation drive and the "Made in China 2025" development strategy, strengthening the technological innovation capability and strength of enterprises, constantly improving the internal innovation system, achieving innovation-driven, quality-first, green development, Structural optimization and talent orientation. By analyzing the product characteristics of the magnetic enterprise and the future development trend, the paper points out the road for innovative magnetic material enterprises.

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