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中国驰名商标

# 中聚 纳米金属粉体

## Nano metal powder

国内领先 国际先进 高纯度 高性能 球形状 易分散

国家发明专利 专利号 200610097610.3

实用新型专利 专利号 ZL200620125220.8

科技部中小企业创新基金 08C26213200595



为您指路 ▶

1. 货车路线为黄色虚线
2. 小车路线为红色虚线
3. 火车站1路公交车至亭林公园转18路至密友公司下



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**密友集团**

昆山市中聚纳米新材料科技有限公司

南京工业大学技术合作

## 中聚金属纳米粉体产品简介

金属纳米粉是指粉体粒径在1~100nm的金属颗粒多晶材料，具有独特的物理、化学效应，因此表现出一系列与普通多晶体和非晶态粉体材料有本质区别的力、磁、光、电、声、光催化和化学催化等性能，从而可广泛应用于电池、陶瓷电容器、大规模集成电路、催化剂、磁流变液体、隐身吸波材料、润滑材料、高性能磁记录材料、生物医药材料、高性能抛光材料以及各种纳米复合材料添加剂等方面，是目前是国民经济各行业及军工高技术产品中重要的基础原材料，具有极大的市场应用前景，其规模化生产对创新、节约、环保型社会的建立具有重要意义。

Metallic nanometer powder refers to the powder APS within 1-100nm metallic grain polycrystalline material with the particular physical and chemical effect. It essentially differs from the the common polycrystalline and amorphous materials. The metallic nanometer particles are widely used in the batteries, ceramics capacitor, LSI, crystallizer, magnetorheological fluid stability, absorbing materials, lubricate material, high performance magnetism recording material, biological medicine industries and etc. It is the key role for the development of both the traditional and high-tech industries at home and abroad. It enjoys a bright market prospect.

金属纳米粉体制备技术是相关高科技产品开发和应用的關鍵，其主要要求和发展方向是：粒子表面清洁；粒子形状、粒径以及粒度分布可以控制；粒子团聚倾向小；容易收集；有较好的热稳定性；易保存；生产效率高，产率、产量大等。但目前国内外产业化中普遍存在粉体纯净度低、产率低、成本高等问题。

The equipment for making the metallic nanometer powder is the key for the development and application of its related high-tech products. Its main requirement and development orientation are: the clean surface of the particles; controlling the shape, the size and distribution of the particles; less clusters; easy for being collected and kept; ideal heat stability; high production capacity and efficiency while the most often problems for the industrilization of the nanometer powders at home and abroad are low purity, low production capacity and high cost.

针对这些问题我公司与南京工业大学合作成功研究开发了年产吨级高质量、高产率、高均匀混合单质纳米复合金属粉体的连续制备设备及工艺，并成功实现了15~200nm不同粒度纳米Fe、Ni、Cu、Ag、Sn、Bi等单质金属粉体和高均匀混合纳米Cu-Ni-Sn粉体的批量生产。与国内外相关技术对比分析结果表明：本公司在纳米金属粉体制备的质量提高、产率提高和成本降低等方面具有较大优势，在粒度相同情况下，铜粉产率提高了1.5倍，镍粉产率提高了2倍，银粉产率提高了5倍，铁粉产率提高了35倍，同时成功制备了高均匀混合纳米Cu-Ni-Sn单质复合粉体。基本解决了现有纳米金属粉气相法生产中存在的产率低、成本高、纯净度低等问题。

In order to solve these problems, our company, on the base on the successful co-operation with the Nanjing University of Technology, has developed the continuous nanometer powder production equipment and technology with an annual output of tons of high-quality, high yield single-mixed Nano-composite metal powders and 15 ~ 200nm different single nano-size Fe, Ni, Cu, Ag, Sn, Bi and evenly mixed nano-Cu-Ni-Sn powder. Comparison with the related technologies analysis at home and abroad shows that: our nano metal powders have a greater advantage in improving the quality, productivity enhancement and cost reduction. Under the condition of the same size, the copper production increased by 1.5 times, Nickel powder yield increased 2 times the rate of silver production increased 5 times the rate of iron production increased 35-fold while the line can also produce the mixed high quality nano-Cu-Ni-Sn single compound Powders, basically solving the existing nano-powder metal gas production in the presence of low-yield, high-cost, low purity issues.

以都有为院士为首的鉴定专家组一致认为：本公司采用的纳米金属粉体连续制备技术中的生产线采用高真空直流电弧等离子体蒸发的工艺连续高效制备高纯度纳米金属及金属复合粉体是本项目的主要创新点；在系统设计、粒度控制、粉体分级等方面具有显著特色。制备工艺中采用的复合蒸发坩埚技术可大幅度提高制备产率，提高能量利用率，降低成本，具有创新性。总体达到国际先进、国内领先水平。

To have academicians led by the expert group agreed that the identification of: the Company's use of nano-metal powders in preparation for the production line for high vacuum evaporation of the DC arc plasma technology for efficient preparation of high purity metals and metal nano-composite powders are The project's main innovation; in system design, control size, grade powder in such areas as a significant feature. Preparation technique used in composite Evaporation crucible technology can significantly increase the yield of preparation, to improve energy efficiency, reduce costs and innovative. Reached the international advanced overall, the leading domestic level.

我公司采用气相法生产的各系列金属纳米粉，具有纯度高(99.7%以上)，球形度高，粒度分布范围窄，结晶度高，利于分散等特点。该产品的各项指标均达到2004年颁布的有关纳米粉体的国家标准(中国唯一已颁布的纳米粉体相关标准)，现已在国家标准的框架内严格制定出企业标准。可按用户要求提供15~200nm范围内的各种金属单质纳米金属粉体和2~3种高均匀混合纳米复合金属粉体。

Our gas production of the series of nano metal powder with high purity (99.7%), high ball, the size distribution of narrow-range, high crystallinity, and conducive to the spread and so on. The indicators are enacted in 2004 to meet the relevant national standards for nano-powder (the only China has promulgated standards related to nano-powder), now the national standard strictly within the framework of the development of a corporate standard. Users can request for 15 ~ 200nm within the scope of a variety of metal nano-quality single-metal powder and 2 to 3 kinds of high-uniform nano-hybrid composite

图片展示：



图 1 等离子体蒸发纳米金属粉体连续制备生产线图片  
continuous metal nano-powder production line of plasma evaporation

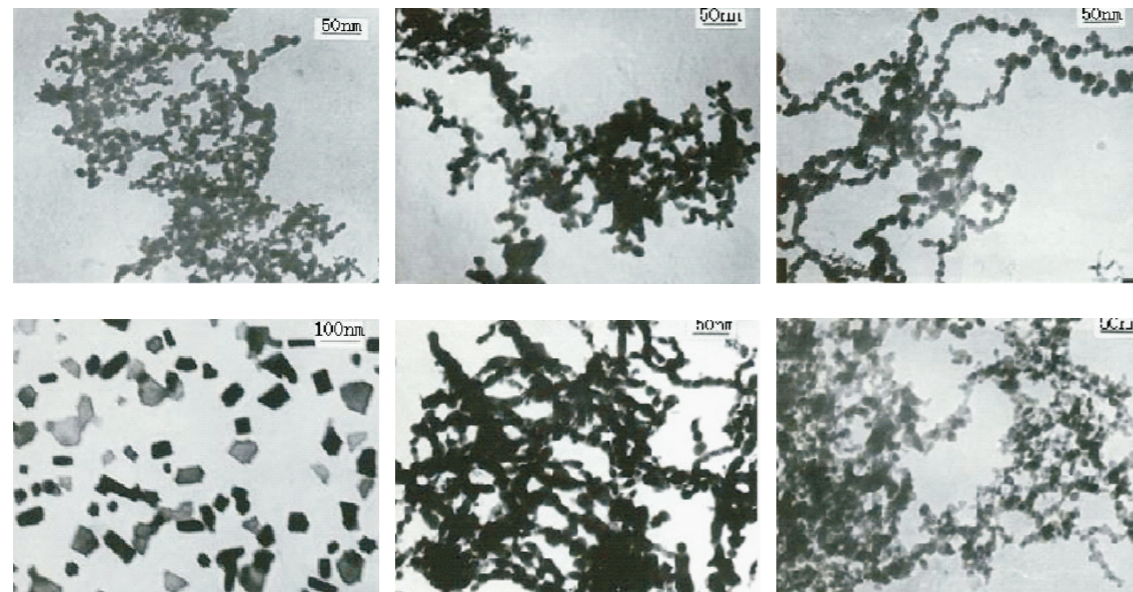


图 2 采用图1设备制备的不同金属纳米粉体图片  
Different metal nanometer powders made by our production line

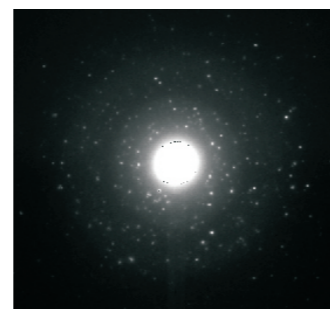
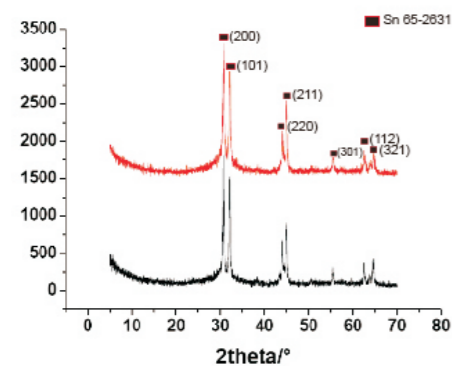
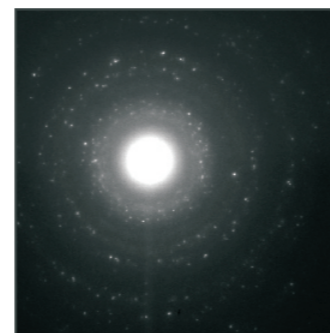
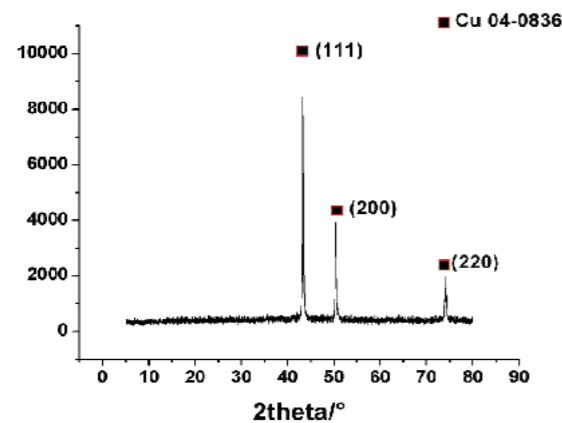
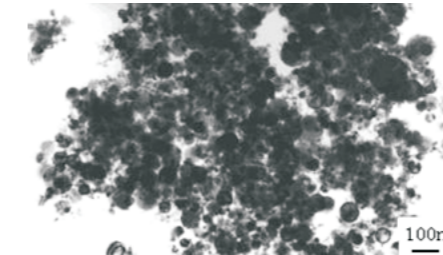


图3 采用图1设备制备的不同金属纳米粉体的XRD、EDS分析图片  
XRD、EDS Image Analysis of Different metal nanometer powders made by our production line

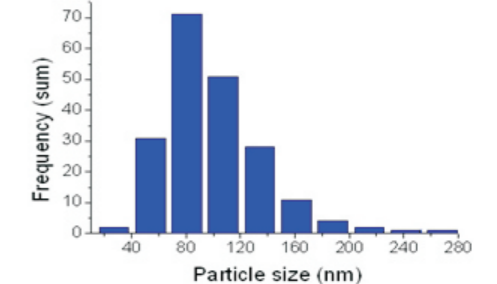
### 纳米级镍粉FNiN

外观：不同粒度纳米镍粉呈灰黑色至黑色，无其他颜色混杂，球形，无明显结块。

Appearance: Nano nickel at different particle sizes looks black grey or black, sphere, without obvious clusters



纳米镍粉TEM测试结果  
Nano-nickel powder TEM test results



纳米镍粉粒度分布测试结果  
Nano-nickel particle distribution test result

### 用途USAGES:

1. 高效助燃剂。将纳米镍粉添加到火箭的固体燃料推进剂中可大幅度提高燃料的燃烧热、燃烧效率,改善燃烧的稳定性。

**Efficacious comburent:** Adding nickel nanoparticle into the solid fuel propellant of rocket increases combustion heat, combustion efficiency and combustion stability.

2. 导电浆料。电子浆料广泛应用于微电子工业中的布线、封装、连接等,对微电子器件的小型化起着重要作用。用镍、铜、铝纳米粉体制成的电子浆料性能优越,有利于线路进一步微细化。

**Conductive paste:** Electronic size is widely used for wiring, packaging and connection in microelectronic industry, it plays an important role in the minimization of electronic device. The electronic paste made of nickel, copper and aluminum nanoparticle has good performance, and it helps further minimize the circuit.

3. 磁流体。用铁、钴、镍及其合金粉末生产的磁流体性能优异,广泛应用于密封减震、医疗器械、声音调节、光显示等

**Magnetic fluid:** The magnetic fluid made of iron, cobalt, nickel and its alloy particles provide excellent properties, they are widely used in seal shock absorption, medical equipment, acoustic adjustment, optical display, etc.

4. 高效催化剂。由于比表面巨大和高活性,纳米镍粉具有极强的催化效果,可用于有机物氢化反应、汽车尾气处理等。

**Efficacious catalyzer:** Due to its large surface and high activity, nickel nanometer has good catalyzing effect, it is applicable to organic hydrogenation reaction, tail gas processing, etc.

5. 高性能电极材料。用纳米镍粉加以适当工艺,能制造出具有巨大表面积的电极,可大幅度提高放电效率。

**High-performance electrode:** Through proper processes nickel nanoparticle can be made into electrode with huge surface, which considerably improves discharge efficiency.

6. 活化烧结添加剂。纳米粉末由于表面积和表面原子所占比例都很大,所以具有高的能量状态,在较低温度下便有强的烧结能力,是一种有效的烧结添加剂,可大幅度降低粉末冶金产品和高温陶瓷产品的烧结温度。

**Actuating sintering additive:** As nanoparticle has large surface and superficial atom ratio, it is in high-energy state, it has good sintering ability even under low temperature, it is an efficacious sintering additive, which substantially lowers the sintering temperature of particle metallurgy products and high-temperature ceramic products.

7. 金属和非金属的表面导电涂层处理。由于纳米铝、铜、镍有高活化表面，在无氧条件下可以在低于粉体熔点的温度实施涂层。此技术可应用于微电子器件的生产。

The superficial conductive coating processing of metal and non-ferrous metal: Due to their high-activity surface, aluminum, copper and nickel nanoarticle can coat under oxygen-free condition below smelting point of the particles. This technology can be adopted in the manufacture of microelectronic devices.

化学成分Chemical composition:

牌号 Grade	化学成分/ w% Chemical composition		
	O	杂质Impurities	Ni
FNiN-20	<2	<0.4	余量margin
FNiN-50	<1.5	<0.45	余量margin
FNiN-80	<1	<0.5	余量margin

注：牌号中的杂质包括B, Al, Si, Cr, Mn, Fe, Co, Cu, Mo, W, P, C, S等元素，需方有要求时，供方可供  
The impurities includes elements such as B,Al,Si,Cr,Mn,Fe,Co,Cu,Mo,W,P,C,S. We offer at your requirement.

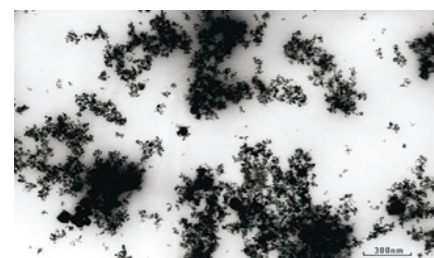
物理性能Physical properties:

牌号 Grade	中位径范围/nm Particle size	比表面积/(m2/g) Specific surface area	松装密度/(g/cm3) Bulk density
FNiN-20	<30	>20	0.04~5
FNiN-50	≥30~60	>15	0.05~0.7
FNiN-80	≥60~100	>8	0.06~0.8

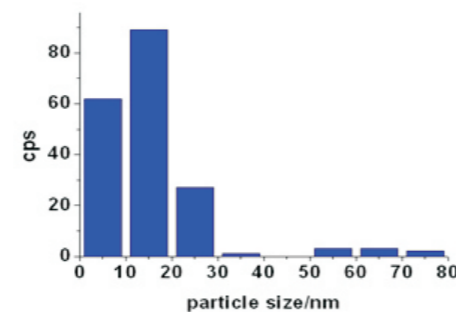
### 纳米级铜粉FCuN Nano Cu

外观：不同粒度纳米铜粉呈紫黑色至黑色，无其他颜色混杂，球形，无明显结块。

Appearance: purple black; sphere; without clusters



纳米铜粉TEM测试结果  
Nano-copper powder TEM test results



纳米铜粉粒度分布测试结果  
Nano-copper particle distribution test result

用途USAGES:

1. 金属和非金属的表面导电涂层处理。纳米铝、铜、镍粉体有高活化表面，在无氧条件下可以在低于粉体熔点的温度实施涂层。此技术可应用于微电子器件的生产。

The superficial conductive coating processing of metal and non-ferrous metal: Due to their high-activity surface, aluminum, copper and nickel nanoarticles can coat under oxygen-free condition below smelting point of the particles. This technology can be adopted in the manufacture of microelectronic devices.

2. 高效催化剂。铜及其合金纳米粉体用作催化剂，效率高、选择性强，可用于二氧化碳和氢合成甲醇等反应过程中的催化剂。

Efficacious catalyzer: Copper and copper alloy nanometer, feature high efficacy and selectivity, can be used as catalyzer in some reactions, e.g. carbon dioxide compound hydrogen to produce methanol.

3. 导电浆料。用纳米铜粉替代贵金属粉末制备性能优越的电子浆料，可大大降低成本。此技术可促进微电子工艺的进一步优化。

Conductive slurry: The electronic size with good performance made of copper nanoparticle instead of valuable metal particles cuts cost to a large extent. This technology is used to the preference of microelectronic processes.

4. 块体金属纳米材料用原料：采用惰性气体保护粉末冶金烧结制备大块铜金属纳米复合结构材料。

Raw material for bulk nanomaterial: Adopt the inert gas to make bulk copper nano composite material with powder metallurgy.

5. 药物添加材料：用于治疗骨质疏松，骨质增生等新特效药的添加材料。

Medicine append material: Ideal append material to the new and highly efficient medicine for curing the osteoporosis and calcaned spur.

6. 纳米金属自修复剂：添加至各种机械设备金属摩擦副润滑油中，实现金属摩擦已磨损部分自修复，节能降耗，提高设备使用寿命及维修周期。

Metallic nanometer self-repairer: Applied to the self-repairing when adding the metallic nanometer powder to the kinds of machinery.

化学成分Chemical composition:

牌号 Grade	化学成分/ w% Chemical composition		
	O	杂质Impurities	Cu
FCuN-20	<3	<0.4	余量margin
FCuN-50	<2	<0.45	余量margin
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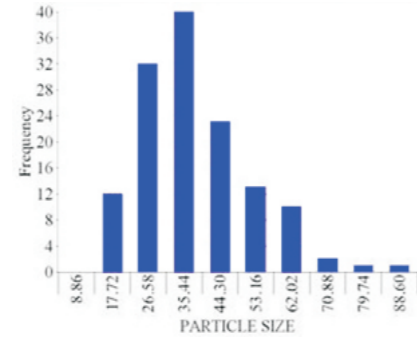
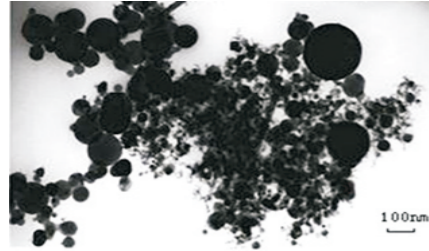
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纳米级铁粉FFeN

外观：纳米铁粉呈黑色，无其他颜色混杂，球形，无明显结块。

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纳米铜粉TEM测试结果  
Nano-copper powder TEM test results

纳米铜粉粒度分布测试结果  
Nano-copper particle distribution test result

用途USAGES:

1. 金属和非金属的表面导电涂层处理。纳米铝、铜、镍粉体有高活化表面，在无氧条件下可以在低于粉体熔点的温度实施涂层。此技术可应用于微电子器件的生产。

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FFeN-80	<3	<0.5	余量margin

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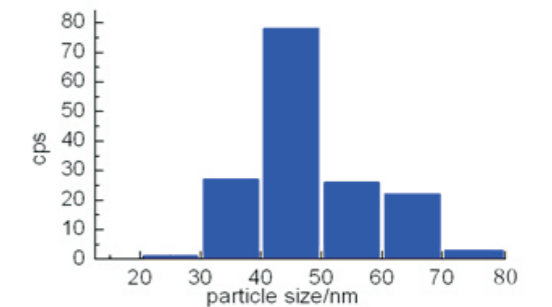
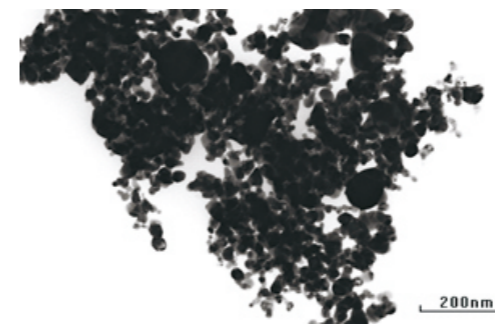
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FFeN-50	≥30~60	>15	0.05~0.7
FFeN-80	≥60~100	>8	0.06~0.8

纳米级银粉FAgN

外观：纳米银粉呈黑色，无其他颜色混杂，球形，无明显结块。

Appearance: nano silver powder in black, no other color mixed, spherical, without apparent agglomeration.



纳米银粉TEM测试结果  
Nano-silver powder TEM test results

纳米银粉粒度分布测试结果  
Nano-silver particle distribution test result

用途USAGES:

1. 抗菌材料。利用纳米银粉具有的高比表面积与高效自催化功能，吸附于细菌细胞表面，阻碍细菌的正常代谢与繁殖，可广泛应用在医用、日用织物及保健用品等。

It is anti-virus to kill the poison: The nanoparticle layer form silver department has no anti-virus powder in machine to have the very strong and anti-virus killing the poison effect.

2. 导电浆料。用纳米银粉替代贵金属粉末制备性能优越的电子浆料。此技术可促进微电子工艺的进一步优化。

Conducting electricity the syrup anticipates: The electronics syrup anticipate the extensive applying in the micro-electronics cloth in the industry line, seal to pack, conjunction etc., to micro-electronics machine piece of small scaled turns to rise to emphasize to want the function. Use the nickel, copper, aluminum, silver nanoparticle flour system of the electronics syrup anticipates the function superior, benefit to the circuit further very small turn.

3. 催化剂。大大提高化学反应速度和效率等，例如乙烯氧化、醇氧化制醛等。

Efficacious catalyzer: Greatly enhance the chemical reaction speed and efficiency, such as Ethylene oxidation.

4. 生物药学：特细纳米银粉用于细胞染色和基因诊断。

Biological pharmacy: he e ilver anopowder an be used in the cell dyeing and the gene diagnosis

化学成分Chemical composition:

牌 号 Grade	化 学 成 分 / w % Chemical composition		
	O	杂 质 Impurities	Ag
FAGN-20	<3	<0.4	余量margin
FAGN-50	<2	<0.45	余量margin
FAGN-80	<2	<0.5	余量margin

注：牌号中的杂质包括B, Al, Si, Cr, Mn, Fe, Co, Cu, Mo, W, P, C, S等元素，需方有要求时，供方可供  
The impurities includes elements such as B, Al, Si, Cr, Mn, Fe, Co, Cu, Mo, W, P, C, S. We offer at your requirement.

物理性能Physical properties:

牌 号 Grade	中位径范围/nm Particle size	比表面积/(m <sup>2</sup> /g) Specific surface area	松装密度/(g/cm <sup>3</sup> ) Bulk density
FAGN-20	<30	>20	0.04~5
FAGN-50	≥30~60	>15	0.05~0.7
FAGN-80	≥60~100	>8	0.06~0.8

纳米铜镍复合粉 (Nanometer Copper and nickel Composite Particle)

1、应用范围:

金属纳米润滑添加剂：添加0.1~0.3%至润滑油、润滑脂中，在摩擦过程中使摩擦副表面形成自润滑、自修复膜，显著降低摩擦副的抗磨减摩性能。与单金属纳米润滑添加剂相比，粉体加入量减少3~5倍，修复时间短，摩擦系数小且长久稳定。块体金属纳米复合材料用原料：采用惰性气体保护粉末冶金烧结制备大块铜镍金属纳米复合材料。

The scope of application: metal nano-lubrication additives: add 0.1 to 0.3 percent from oil, grease, in the process of Moldova Moldova Sassafras Sassafras Vice self-lubricating surface, he studied Film, a significant reduction in the Mount Sassafras, deputy anti-wear friction-reducing properties. And a single metal nano-lubrication additives, to reduce the amount of powder by adding three to five times, to repair a short time, Mount Sassafras coefficient of small and long-term stability. block of metal nanocomposite materials used: inert gas protection of the powder sintering Preparation large copper-nickel metal nanocomposites.

2、产品特征:

高纯净度、粒径均匀、球形状、分散性好、烧结收缩性小、松装密度0.8g/cm<sup>3</sup>、深蓝黑色粉末。包装：内衬防静电塑料袋封装，100~1000g分袋。

the product features: high purity, uniform size and shape of the ball, good dispersion, the sintering shrinkage of small, density 0.8g/cm<sup>3</sup>, dark blue black powder. packaging: a plastic bag lined anti-static packaging, 100 ~ 1000g sub-bag.

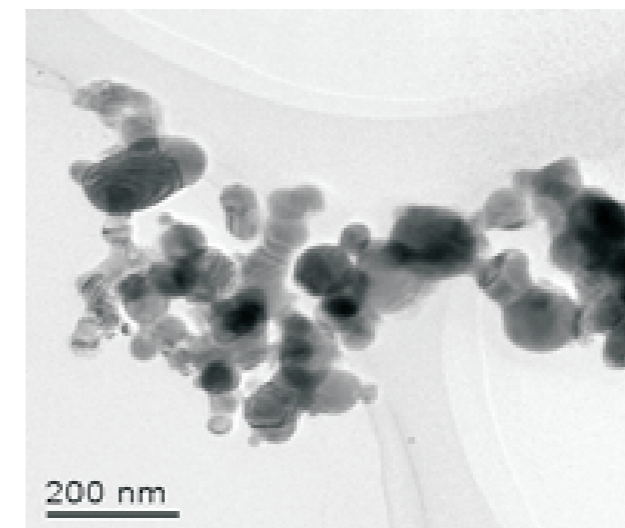
3、产品规格:

可制备粒径与成分可控的各种高均匀混合型单质纳米铜镍复合粉。

product specifications: Size and composition of a variety of high-quality single-uniform hybrid nano-copper-nickel composite powder can be controlled

4、相关分析数据

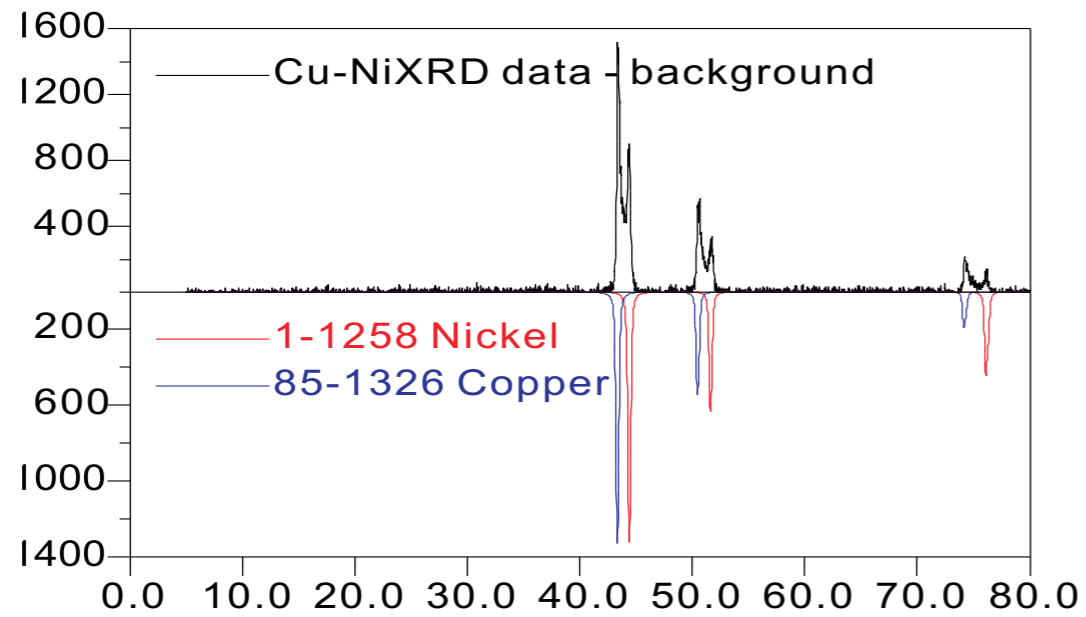
(1) 电镜图 Electron micrographs



(2) 粒度分布图 Particle size distribution



(3) XRD (晶粒度50nm)



(4) 平均粒径50nm, Cu60%、Ni40%复合粉体的XRF分析结果

Average particle size 50nm, the XRF analysis of composite nanopowder Cu60%、Ni40%

El	Wt. %	StdErr
Cu	59.91	0.25
Ni	39.38	0.24
S	0.040	0.0021
Al	0.037	0.0027
Mn	0.0088	0.0008
Pb	0.0048	0.0016

2008年7月23日密友集团有限公司揭牌  
July 23rd, 2008, Miyou Group Founded



2008年3月密友集团纳米金属粉体连续制备技术和纳米复合润滑自修复剂产品通过以都有为院士为组长的专家组国家级鉴定  
Miyou Group's nano metal particles continuous production technology & nano composite self-repairing lubricants new products have been authenticated by the national new expert team on date of March, 2008.

2009年10月25日中国科学院上海高等研究院和密友集团合作挂牌仪式隆重举行

On October 25th, 2009, the opening ceremony for the cooperation between Chinese academy of sciences, Shanghai institute of advanced study and Miyou Group Co.,Ltd was held.



全国人大常委会副委员长顾秀莲(左一)在《节能减排》会议上接见吴建明董事长(左三)

图左二为: 中国化工报社社长郝长江先生  
图左四为: 巴斯夫大中华地区总裁关志华先生  
Gu xiulian-Vice-chairman of People's National council interviewed Mr. Wu Jianming in the Emission reduction and energy-saving meeting.

Left pic. Second: Mr. Hao Changjiang-China Chemical magazine proprietor  
Left pic. Fourth: Mr. Guan Zhihua-BASF China area CEO