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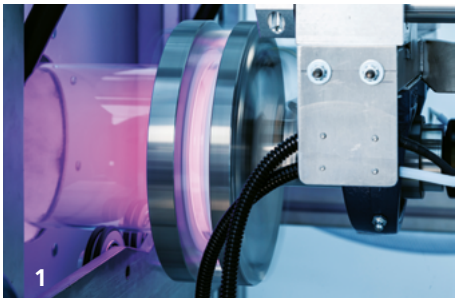

MICRO- AND NANOPARTICLES BY RF PLASMA

SYNTHESIS, TRANSFORMATION, MODIFICATION, ALLOYING AND PURIFICATION

1 *By means of a plasma reactor ceramic and metal nanoparticles can be specifically produced and modified.*

Starting Point

Metal and ceramic powders are the basis for many technical and industrial processes and applications, such as powder metallurgy, thermal spraying, electronics and catalysis. Nevertheless, there is still a need for developments, because the powdery raw materials eventually determine the properties of final products and may be the cause of the problems in the processing of these: Impurities or corrosion processes at the powder production (e.g. by the grinding processes) can have an disadvantageous effect, or the particle shape leads to a greater abrasion or a rough coating texture.

At the same time market requirements are changing more and more quickly and frequently. To be able to react to this, manufacturers require flexible, fast solutions for development, production and quality assurance. Thereby, the high melting point of metals such as tungsten or titanium or technical ceramics (tungsten carbide), which are important for hard alloys, is an additional challenge.

Solution approach IPA

Fraunhofer IPA uses the capabilities of the RF plasma process, where different methods can be performed in fast 1-step processes to convert (spheroidisation), modify, alloy, purify or synthesize powdery – even refractory materials:

- Particle spheroidisation:
  Increase of flowability, density, purity of the particles; reduction of abrasiveness and internal porosity
- Modifying and coating of the surface/ doping of particles
- Microalloying:
  flexible melting and alloying even of refractory metals
- Material purification:
  Removing oxygen and other impurities
- Synthesis of nanoparticles:
  From liquid, powdered and gaseous raw materials in high-purity process without drying

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Powder Category		Powder Name
Ceramics	Oxide	SiO_2, ZrO_2, YSZ, Al_2O_3, TiO_2, Glas
	Sub-oxide	ie = SiO_x (x can be fine tuned/Feedstock =SiO_2)
	Non-oxid	WC, WC-Co, CaF_2, TiN
Pure metals		Si, Re, Ta, Mo, W
Alloys		Cr/Fe/C, Re/Mo, Re/W

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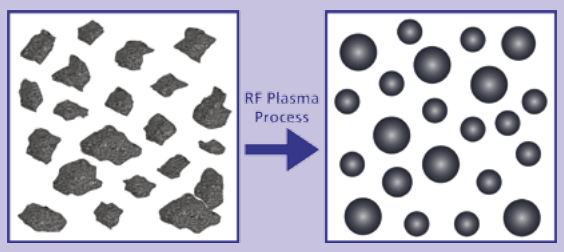

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Functional advantage

All processes are carried out under a controlled atmosphere (argon as inert gas). The produced particles can be transferred locally also under argon (preservation of properties) or can be used in further chemical functionalization/processing/testing (e. g. with solvents).

2 *Powders while can be spheroidised.*

3 *Principle of spheroidisation.*

Our services

Fraunhofer IPA offers to investigate – using the RF plasma process – the improvement/modification of the properties of metal/ceramic powders, which have already been applied by the customer, according to his requirements: The customer can then check the powder in his own processes. Alternatively, Fraunhofer IPA can test these powders in different finishing processes where it has already many years of experience, for example: chemical functionalization, sintering, melting and coating. Examples of materials that can be processed by RF plasma at the Fraunhofer IPA are listed in Table 1. For new materials a preparation method can be developed.

Your benefits

With the RF plasma process high quality metal and ceramic powders can be manufactured and modified reproducible in a controlled atmosphere. The simple and fast 1-step-processes save time – even for refractory materials.

The customer can check the modified powders in his processes without additional investments in new plants. This allows a flexible and fast respond to fluctuating market demands and improvement of existing products or development of new ones. In addition, the process parameters obtained are already the basis for later upscaling.