Hybrid reactor for the production of submicronic and nano particles in crystallized matrix.

Abstract **Priority Number** The present invention relates to a unique n. 102019000022335 27.11.2019. innovative integrated reactor for the **KEYWORDS** production and the incorporation in a matrix of crystallized solid of submicronic particles Patent Type □ NANOPARTICLES and nanoparticles of inorganic and/or Patent for invention. organic materials, to a process that takes □ CRYSTALLIZATION place in the designed apparatus and to the Uscita fluido di servizi uses of the submicron particles and **Ownership** □ CHEMICAL embedded nanoparticles obtained with this REACTORS Sapienza Università di Roma 100%. equipment. In particular, the invention refers to the □ MICRO-MIXING integration in a single intensified equipment Inventors Fluido di servizi □ SDR of a rotating disk reactor and a crystallizer. Giorgio Vilardi, Nicola Verdone, Marco The equipment allows to obtain directly the Stoller. incorporated product by limiting the possibility of deteriorating the particles Fig. 1 front section of the integrated apparatus object AREA of the present invention. produced. Industrial & Commercial Reference Process and fine chemistry, biomedical, □ NANOTECHNOLO-GIES & MATERIALS electronic, food, environment protection Fig. 2 Legend of Figure 1. Legend **Time to Market** • Reagent 1: metallic precursor solution (prepared in the solvent of the salt used for the crystallization) Pilot-scale tests are necessary before its • Reagent 2: reducing agent (prepared in the solvent of the salt used for the crystallization) industrialization (TRL 4). CONTACTS • Inert gas (eventual): Nitrogen/Argon • 1: Eletric moto PHONE NUMBERS • 2: Shaft of the upper spinning disk reactor +39.06.49910888 **Availability** • 3: Spinning Disk +39.06.49910855 • 4: Differential gear unit Research, Development ρ • 5: Shaft of the axial turbine of the crystallizer > EMAIL Experimentation. • 6: Axial impeller of the crystallizer u brevetti@uniroma1.it • 7: Baffles of the crystallizer • 8: Case of the jacketed reactor • 9: Valve of the produciti outlet line • 10: Off-gas outlet



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Hybrid reactor for the production of submicronic and nano particles in crystallized matrix.

Technical Description

The object of the following invention is an integrated apparatus consisting of a rotating disk reactor placed at the top of a stirred vat reactor that functions as a continuous or discontinuous crystallizer. The solute can be initially dissolved in the solutions of the reagents for the production of the particles or introduced directly into the crystallizer. The production of the particles can take place both by liquid / liquid, liquid / solid, gas / solid, and gas / liquid reactions, with or without the use of an inert atmosphere. The particles are produced on the rotating disk in the top area of the equipment.



Fig. 3 Top view of the reactor.

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Technologies & Advantages

The advantages of the present invention are:

1) The sizing and construction of the equipment, which is based on the separate design of the two basic technologies, are simplified as it is a known art and, also from the control point of view, the two processes turn out to be decoupled.

2) The incorporation of the solid particles is done to target their packaging, to allow long-term storage of the same without the need for further protection from both chemical and physical deterioration. The use of a single equipment that allows to get from the production of the particles to their complete packaging guarantees the achievement of the chemical-physical characteristics of the product and the maintenance of the chemical activity of the embedded particles.

3) Similarly, transportation is made easier and the handling of the product.

4) The equipment can be operated continuously or in semi-batch.

5) The equipment can be easily integrated into existing or newly designed production cycles.

6) The scale-up of the equipment is easy, up to at the capacity of hundreds of kg of product per hour.

Applications

The present invention allows to produce nano or microparticles characterized by a high purity, which can be used as heterogeneous catalysts in industrial chemical processes, for the production therefore of products of fine and pharmaceutical chemistry, in the medical and biomedical field, in the electronic industry, in the environmental and food sectors. The metallic or active (oxidizable) particles are already "packaged", i.e. incorporated in a matrix of crystallized solid which maintains the characteristics of the particles unvaried during the transport and storage phases and which is easily removable once dissolved in one of the solvent of the solid.



Fig. 4 Transversal section of the reactor.



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