



A Wire Explosion Assembly for Producing Metallic Nanoparticles and a Method Thereof IITM Technology Available for Licensing

Problem Statement

- Generally, nanoparticles are produced from the **atomization, liquid phase reduction**, method using **plasma & wire explosion process (WEP)** that is effective due to its inherent advantages in controlling particle size.
- The exhaustive procedure not only requires **human intervention** to fix the wire, supply the sufficient energy and control the spark gap, but also **consumes a lot of time** in collecting the nanopowder after the explosion, creating **hindrance** in the mass production.
- Thus, there is a need for **a method & device** that overcomes above-mentioned disadvantages of **a convention wire explosion process for the creation of nanoparticles.**

Technology Category/ Market

Category: Micro & Nano Technology, Chemistry & Chemical Engineering

Industry: Wire & cable Manufacturing

Applications: Drug Delivery, Nano-catalysts For Chemical Synthesis & Fuel Cells, Sensors, Micro And Nano-fluidics.

Market: The global nanomaterials market was valued at **\$16.3 billion in 2021**, and is projected to reach **\$62.8 billion by 2031**, growing at a **CAGR of 14.6%** from 2022 to 2031.

Technology

The present patent discloses a wire explosion assembly and the method for producing metallic nanoparticles, comprising:

a wire explosion chamber connected with a wire feeding unit and a pair of pneumatic cylinders and a pair of electrodes;

a controller configured to control the wire feeding unit and the pair of pneumatic cylinders in such a manner that: the wire feeding unit provides a metallic wire supply towards the wire explosion chamber;

and the pair of pneumatic cylinders comprising a horizontal pneumatic cylinder and a vertical pneumatic cylinder

Wherein:

- The pair of electrodes comprises **a high voltage electrode and a ground electrode.**

- The **yield and size** of metallic nanoparticles is **controlled** by varying at least one of the power supply to the pair of electrodes; thickness of the metallic wire; and pressure applied in the wire explosion chamber.
- The wire explosion chamber is provided with **inert gas atmosphere, non-stick walls, & flat base.**
- The pair the electrodes are provided with the **power supply for 20s**, once the metallic wire to be exploded is clamped over the pair of electrodes.
- The movement of the horizontal pneumatic cylinder and vertical pneumatic cylinder is **controlled by a pair of pneumatic valves.**

Method

• providing a metallic wire supply, by a wire feeding unit, to a wire explosion chamber;

• guiding by a horizontal pneumatic cylinder, the metallic wire supplied by the wire feeding unit inside the wire explosion chamber in a horizontal direction, such that the metallic wire to be exploded, is aligned with a pair of electrodes;

• retracting movement of the horizontal pneumatic cylinder in the horizontal direction and restricting the metallic wire supply from the wire feeding unit, once a predetermined length of wire is reached;

• cutting the metallic wire supply, by an isolated wire cutter, at entry point of the wire explosion chamber once the wire is clamped on the pair of electrodes;

• providing a power supply through the pair of electrodes, once the metallic wire gets aligned over the pair of electrodes, in the fixed position for exploding and thereby producing metallic nanoparticles.

Intellectual Property

IITM IDF No.: 2223 ; Patent No.: 418684 (Granted)

TRL (Technology Readiness Level)

TRL – 3; Proof of Concept

CONTACT US

Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
<https://ipm.icsr.in/ipm/>

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in

Phone: +91-44-2257 9756/ 9719

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Images

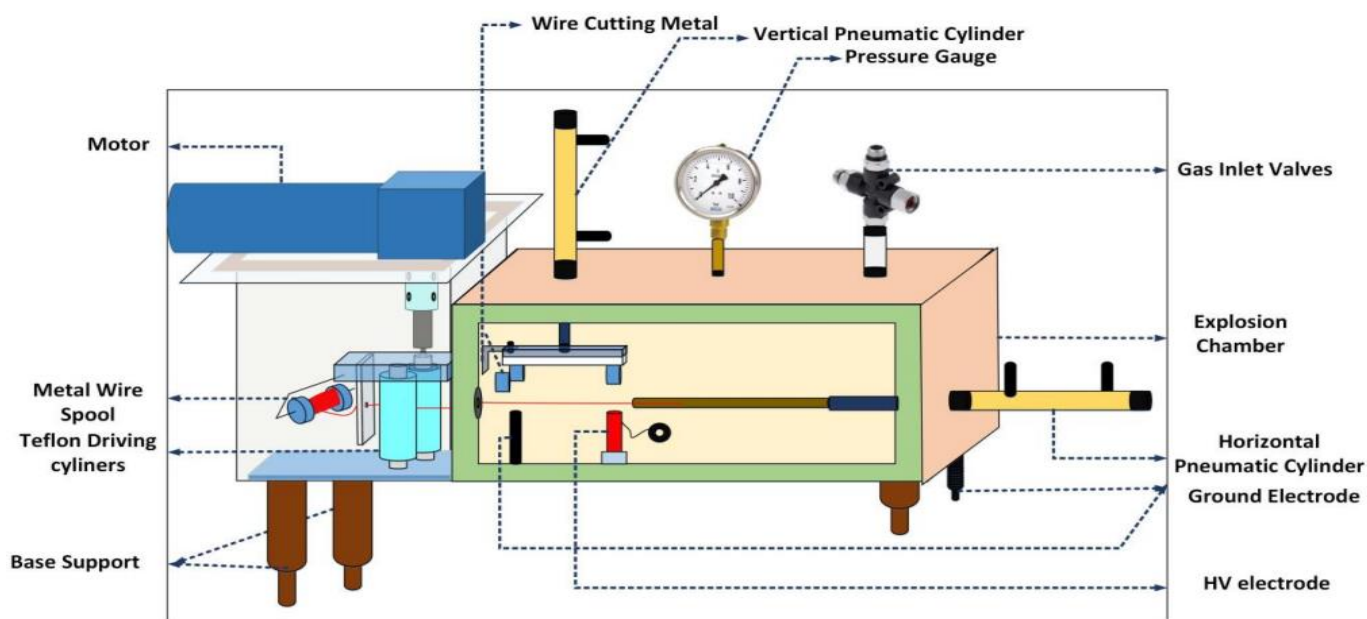
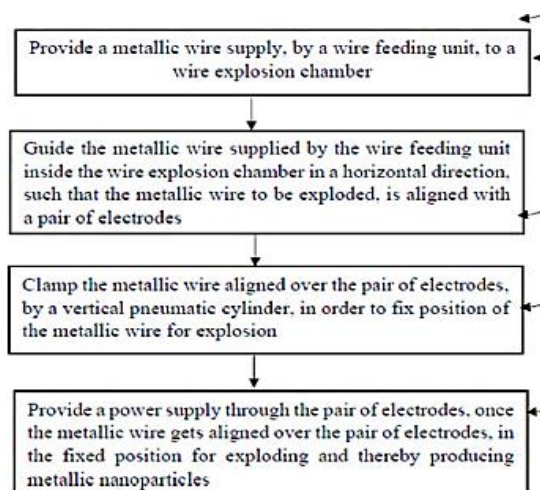


Figure 1: Schematic diagram of Automation Unit

Figure 2: Method to produce Nanoparticles

Key Features / Value Proposition

- It provides **hustle free guiding path** for the metallic wire fed properly in explosion reactor and **helps wire to settle over electrodes**.
- Preserving the metallic content is important to utilize the produced **high purity unoxidized nanoparticles** in real time applications.
- The present art is composed of a **wide base and non-stick powder reactor**, which encompass the produced powder in the chamber, resulting in **higher collection efficiency** of produced powder almost counting **90 to 95%**.
- The **increased length** of the wire in comparison with the existing length **improves the production yield by 62.5%**.
- It provides **higher yield** with **controllable sizes** of metallic nanoparticles by varying parameters.
- It can **transmute the solid metallic wire** into size controllable nanoparticles in the range of **microseconds** in each of the explosion cycle.
- It provides a **strong support** and grip for the **fed wire** with the help of pneumatic cylinders, for the **flawless** explosion in every cycle.



Research Lab

Prof. Jayaganthan

Department of Engineering Design

Prof. Chakravarthy S R

Department of Aerospace Engineering

Prof. SARATHI R

Department of Electrical Engineering

CONTACT US

Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
<https://ipm.icsr.in/ipm/>

Email: smipm-icsr@icsrpis.iitm.ac.in

sm-marketing@imail.iitm.ac.in

Phone: +91-44-2257 9756/ 9719