IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

METHOD FOR GENERATION OF NANOPARTICLES USING ADVANCED MECHANICAL MICRO-MACHINING TECHNIQUE

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Micromachining** is essential for advanced materials in aerospace, defense, and automotive industries.
- **Electrical Discharge Machining (EDM)** is a cost-effective method for machining hard and brittle materials**, but tool wear is a major issue**.
- **Nanotechnology** is increasingly important in producing nanoparticles with novel properties, which are used in various fields.
- **Studies on nanoparticle** properties using micro-EDM have shown improvements in machining stability, efficiency, and quality.
- **Micro-EDM removes material** through **melting and evaporation** through repetitive spark discharges.
- There is a **need for collection, reveal, control, and testing** of debris structure, highlighting potential use in industrial or medical applications.

TECHNOLOGY CATEGORY/ MARKET

Technology: Method for Generation of Nanoparticles
Category: Micro & Nano Technologies
Industry: Manufacturing /chemical, Automotive, Biomedical
Application: Micro machining, Production of Nanoparticles
Market: The global market size is estimated to grow from **USD 5.1 billion in 2023 to USD 15.1 billion** by **2035,** representing a **CAGR of 9.4%** during the forecast period **2023-2035**

INTELLECTUAL PROPERTY

IITM IDF Ref. 1209
Patent No: IN 347900

TRL (Technology Readiness Level)

TRL- 3, Experimental proof of concept

Research Lab

Prof. Somashekhar S Hiremath,
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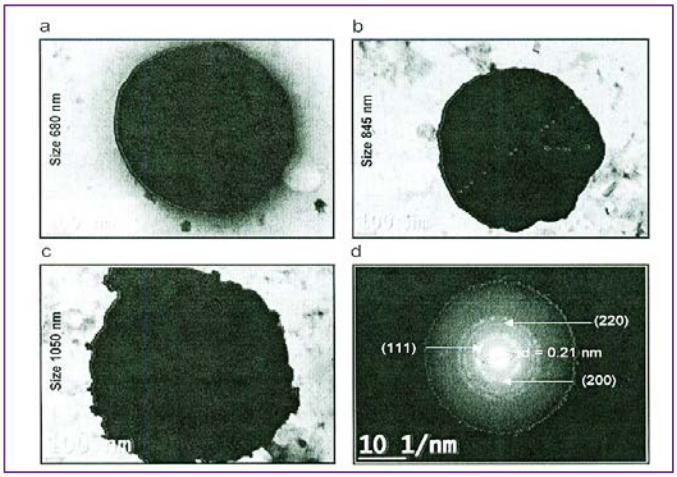
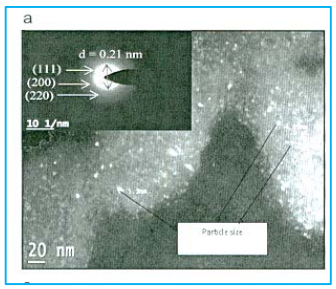
TECHNOLOGY

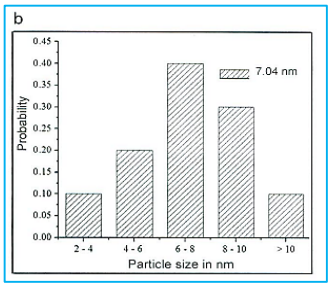
The below figure shows the (a,b,c) images of TEM and (d) images of SAED copper particles generated in pure DI water after drying the synthesized colloidal suspension at ambient temperature



(a) TEM image of Cu nanoparticles with PVA sample (SAED in inset shows the Cu diffraction pattern),

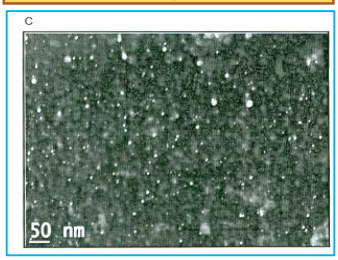
(b) histogram showing particle size distribution (PVA sample),

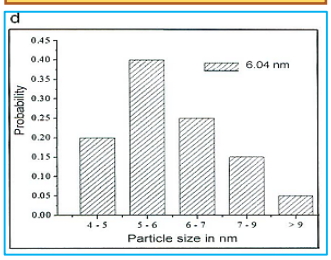




(c) TEM image of Cu nanoparticles with PEG sample,

(d) histogram showing particle size distribution (PEG sample)





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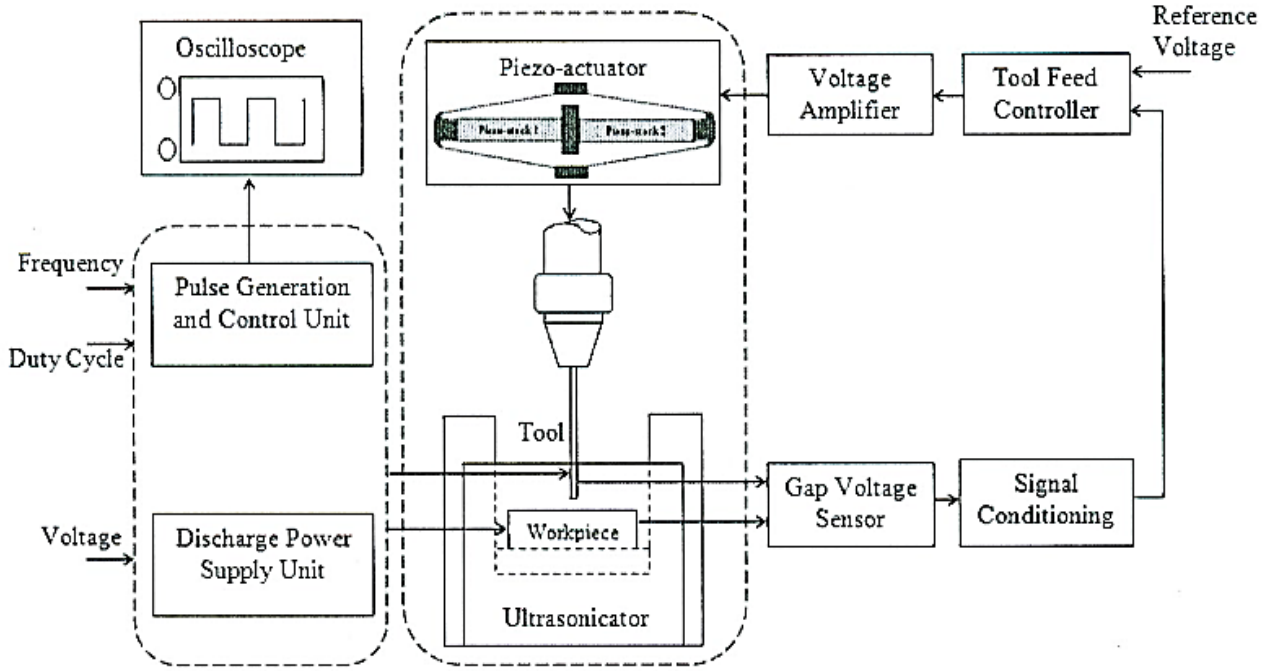
Block diagram of a Tailor made micro-EDM setup



Key Features / Value Proposition

- **Nanoparticle Generation System**
  - Micro-Electrical Discharge Machining System
- **Method for Tool Vertical Displacement**
  - Non-contact mechanical method
- **Controlled by an amplified piezoactuator** with a maximum **Displacement**
  - 400 µm at 150 V.
- **Supply voltage**
  - Ranges from 10-120 V.
- **Pulse duration**
  - Adjustable at any time.
- **Pulse frequency**
  - Ranges from 1kHz -5 kHz.
- **Duty cycle**
  - Ranges from 5% - 50%.
- **Pulse duration**
  - Less than 100 µs.
- **Size**
  - Nanoparticles generated in size less than 100 nm with high yield
- **Base fluid for colloidal suspension**
  - Uses DI water
- **Stabilizer**
  - Uses organic/inorganic stabilizer for suitable nanoparticle size and shape.
- Technique also **applicable for hybrid nano particles**.
- **Nanoparticles** generated from conducting, semiconducting, and electrically conducting materials.
- **Simple, straightforward, and economical process** based on thermoelectric energy between **tool and workpiece electrodes.**
- Utilizes a **custom-made setup** with a piezoactuated tool feed system.

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