IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

A METHOD TO TRANSFORM CRYSTALLINE MINERALS TO NANOPARTICLES BY MICRODROPLETS

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Soil** is formed by the **weathering of rocks**.
- While physical, chemical, and biological weathering occurs.
- The process of **soil formation is slow**, taking **millions of years**.
- There is a **need for breaks the common minerals such as quartz and ruby to nanoparticles in micro droplets**.
- **Microdroplets** are known to cause chemical synthesis at an accelerated rate or convert large protected nanoparticles of **10-50 nanometer in diameter** to smaller ones of **3-5 nanometer in diameter.**

TECHNOLOGY CATEGORY/ MARKET

Technology: Transform Crystalline Minerals to Nanoparticles
Category: Nano Research
Industry: Soil Testing/Nano particles
Application: Mining Process, Soil health management.
Market: The global market size was valued at **USD 4679.88 million in 2022** and is **expected to expand at a CAGR of 5.65%** during the forecast period, reaching **USD 6507.29 million by 2028**.

INTELLECTUAL PROPERTY

IITM IDF Ref. 2388
Patent No: IN 539562 ,
PCT No: PCT/IN2023/050649

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

Prof. Pradeep T,
Dept. of Chemistry.

TECHNOLOGY

Method

❖ A **Method to Transform Crystalline Minerals to Nanoparticles**, Comprises

a. **Grinding crystalline minerals** to **obtain particles** in
   - ~1-**5** micrometer scale;

b. **Mixing grinded particles** in **distilled water**
   - to form a **suspension of particles;**

c. **Spraying the charged microdroplets** of
   - **0.1 mg/ml** suspended particles at spray potential
   - in the range of **4 kV through a 50 µm** inner diameter capillary
   - at a flow rate of **0.5 ml/h** onto the substrate at a distance of **1.5 cm from the tip**

d. **Collecting the nanoparticles** from the **substrate;**

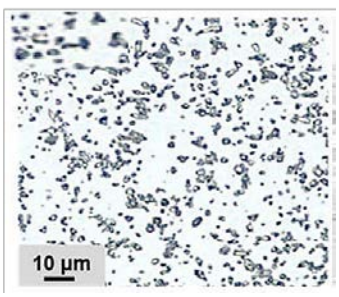

Fig 1 shows a **Optical image** of the **natural quartz**.

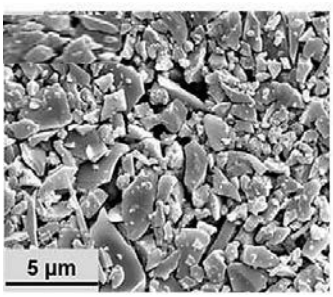

Fig 2 shows a **FESEM image** of a natural quartz showing the **size range of particles** between **1-5 um.**

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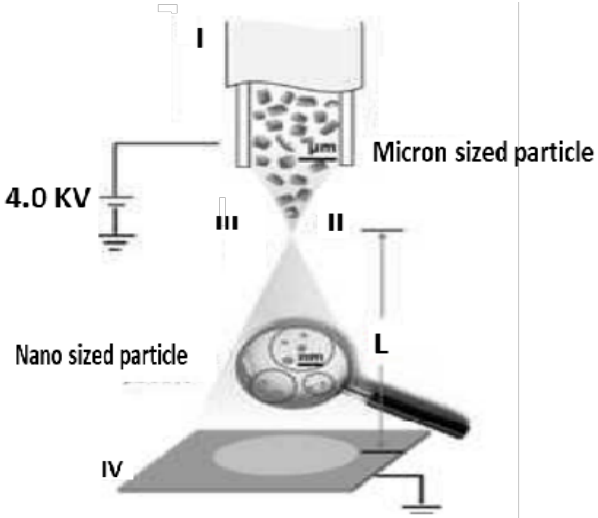
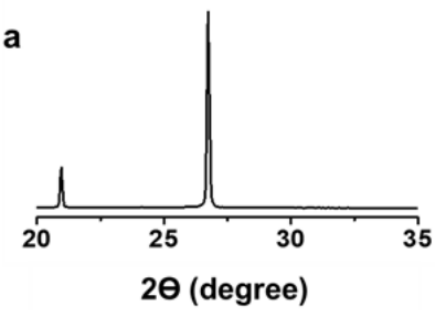
Schematic representation of disintegration of mineral particles in microdroplets

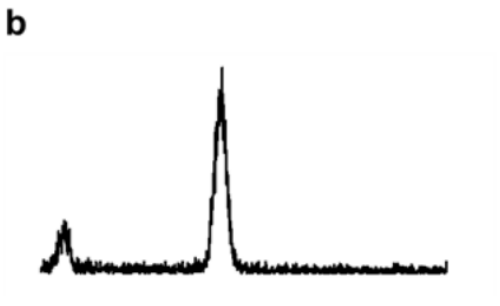


Symbol	Description
I	**Syringe** filled with particle suspension
II	**spray emitter**
III	**Taylor cone** emerging from the **electrospray**
IV	**Conducting** surface at a distance of **L=1.5 cm** from the tip of the emitter

XRD analysis showing the characteristic planes of natural quartz.



a. Before electrospray deposition.



b. After electrospray deposition

Key Features / Value Proposition

- **Minerals to Nanoparticles**
  - **Charged micro droplets** can break common minerals such as quartz and ruby to nanoparticles.
  - **Electrospraying** of particles leading to the formation of nanoparticles.
  - Electrospray produces nearly **uniform nanoparticles** upon optimizing the conditions
- **Source of materials**
  - Natural minerals
- **Microdroplet medium**
  - Water
- **Resultant sizes**
  - **5-10 nm**
- **Size changes** (From starting to final product)
  - Micron particles to Nanoparticles
- **Technical specifications**
  - 4.0 kV applied potential
- **Do not use**
  - Stober's process and microemulsion method
  - eternal laser power
  - sol-gel method.
- Method is **simple** and used **ambient microdroplet synthesis.**

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