# International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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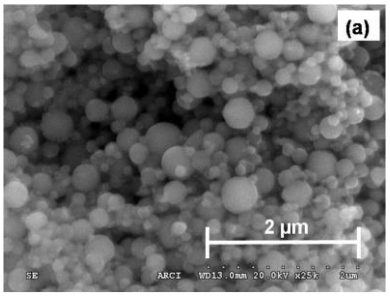
## Ultrafine Aluminum Powder for Propellant Applications

### Overview

Ultrafine aluminum powder (UFAP) is commonly used in a wide variety of applications like rocket propellant additives, thermite mixtures, paints and hydrogen generation, *etc* due to its reduced ignition delay and temperature thus leading to complete combustion of particles. Though UFAP can be synthesized by a number of techniques, radio frequency induction plasma (RFIP) offers inherent advantages over other techniques. The purity of the powder is ensured since RFIP setup has no electrodes. The productivity is also reasonably high ~0.5–1 kg/hr, depending upon the material and its feed rate. The precursor powder carried by a carrier gas passes through the injection probe and gets delivered into the plasma chamber. The vaporized precursor is then subjected to a drastic quench as it comes out of plasma chamber.

### Key Features

- Ultra fine Al increases burning rates; required for solid or liquid propellant
- Import embargo
- ARCI has got capability to make Al nano powder in kg levels
- Ability to tailor the particle size and its distribution
- Metallic aluminium content as high as 90%
- Predominantly displays an exothermic peak compared to micron sized Al powder



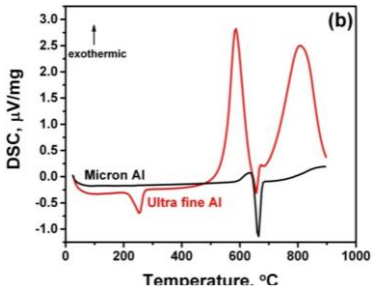

SEM morphology of ultra fine Al powder

### Potential Applications

- Propellant additives for both solid as well as liquid propellants
- Sintering additives
- Coating applications
- Thermit welding applications
- Hydrogen generation

### Technology Readiness Level 5

- Synthesis of powder at kg levels were demonstrated
- One kg of powder delivered to SF Complex, Jagdalpur, DRDO for field trials




Thermal characteristics of ultra fine Al powder in comparison with micron sized powder

| IPDI* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activities** | *Basic concepts and understanding of underlying scientific principles* | *Short listing possible applications* | *Research to prove technical feasibility for targeted application* | *Coupon level testing in stimulated conditions* | *Check repeatability/ consistency at coupon level* | *Prototype testing in real-life conditions* | *Check repeatability/ consistency at prototype level* | *Reassessing feasibility (IP, competition technology, commercial)* | *Initiate technology transfer* | *Support in stabilizing production* |
| **Status** | | | | | | | | | | |

**Publications**: P.Sai Karthik, S.B. Chandrasekhar, D. Chakravarty, PVV Sriniuvas, VSK. Chakravadhanula, TN Rao, Propellant grade ultrafine aluminium by RF induction plasma, Advanced Powder Technoilogy, 29, 804-12, 2018

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