Powder–Based Work at Edwards AFB

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Report Documentation Page

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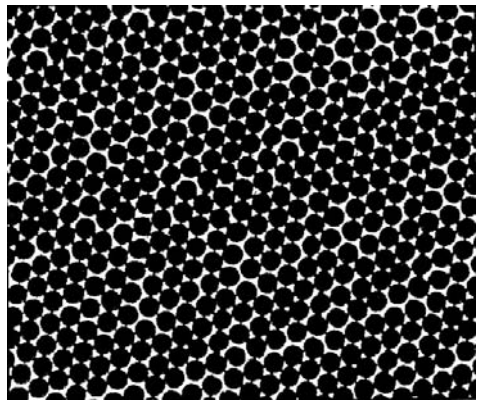
Areas of Interest

- Bulk nanophase aluminum parts for aerospace and astronautics applications

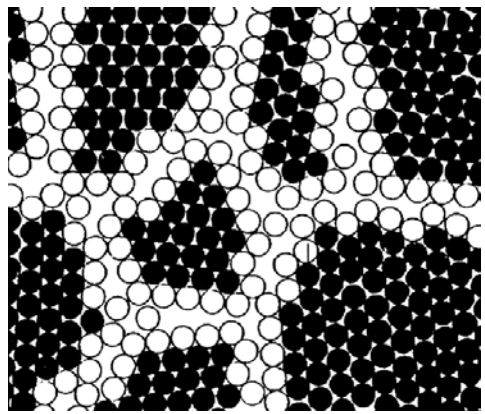
- Metallic coatings for microtube components

What are Nanocrystalline Materials?

- They are polycrystalline materials with crystallites that have nanometer rather than micron dimensions.
- In contrast to conventional course-grained materials, the number of atoms in the grain boundaries can equal or exceed those in the crystal lattice sites.
- They are materials with superior properties which include: increased strength (for aluminum it increases from 29 ksi to 115 ksi) while maintaining ductility (5%)



Conventional Material



Nanocrystalline Material

Nanophase Aluminum
Applications

- This material is being developed to replace titanium which is expensive and susceptible to both hydrogen embrittlement and mass loss by hydride formation.

- Nanocrystalline aluminum is compatible with hydrogen, and compared to titanium has lower density, improved fatigue life, and is easier to fabricate.

- Other applications include: Supersonic aircraft skins and space structures.

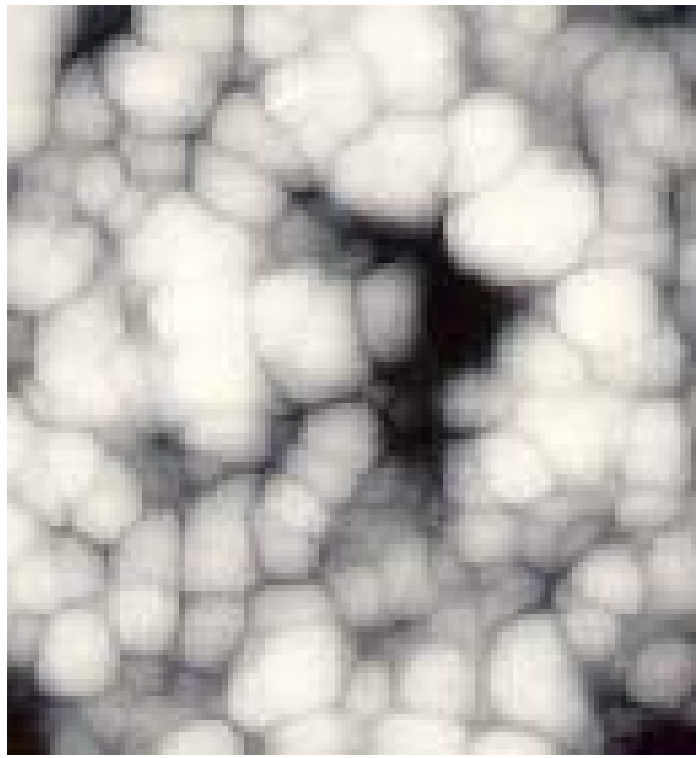
Process

Attrite aluminum powder under surfactant to minimize oxidation.

Dry powder under inert atmosphere

Compact powder employing cold isostatic press (CIP)

Process compacted part



500nm

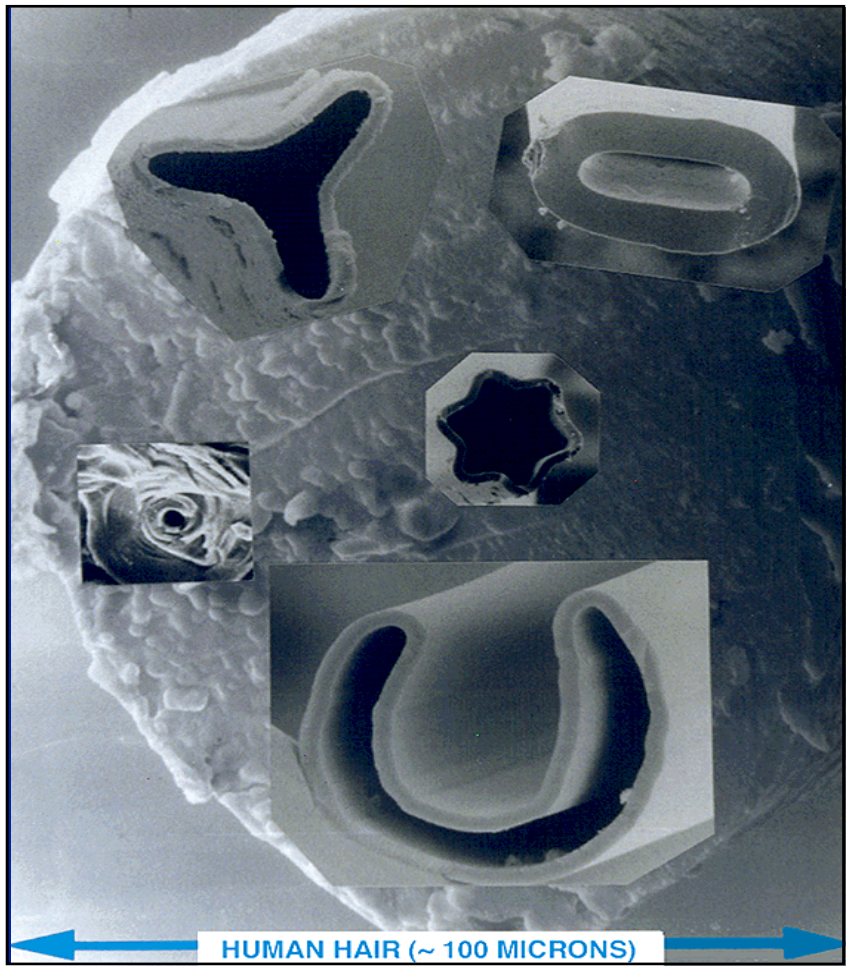
AFM of
Nanophase AL

Nanophase Aluminum Facility

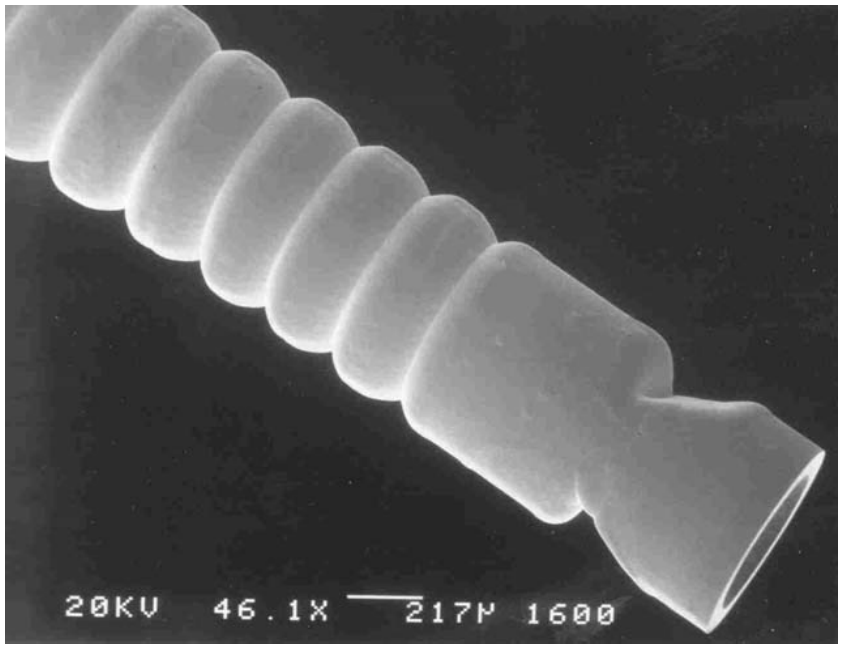
Microtubes and Microtube Composites

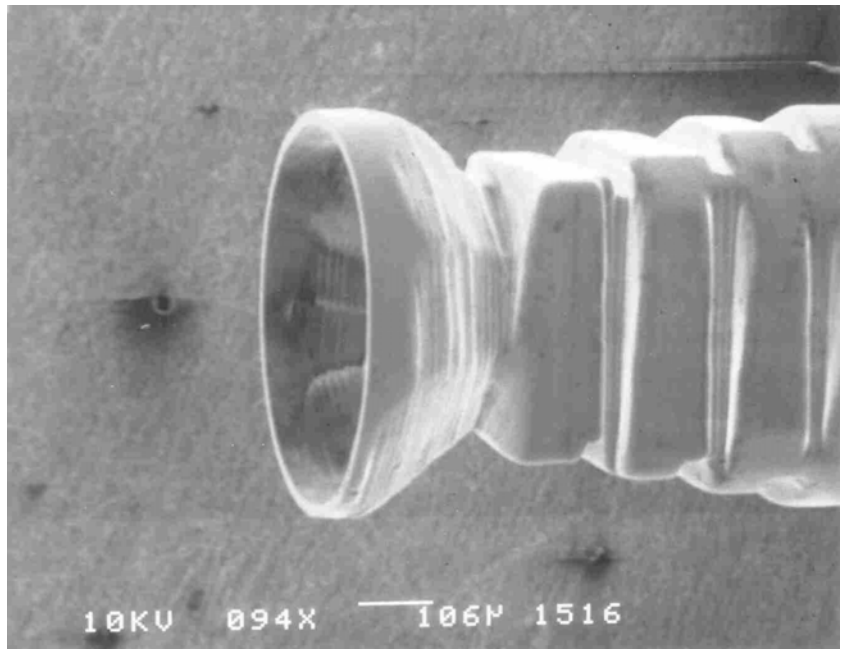
How many Microtubes can Fit in a Human Hair?

(It Depends on How Small You Make Them)



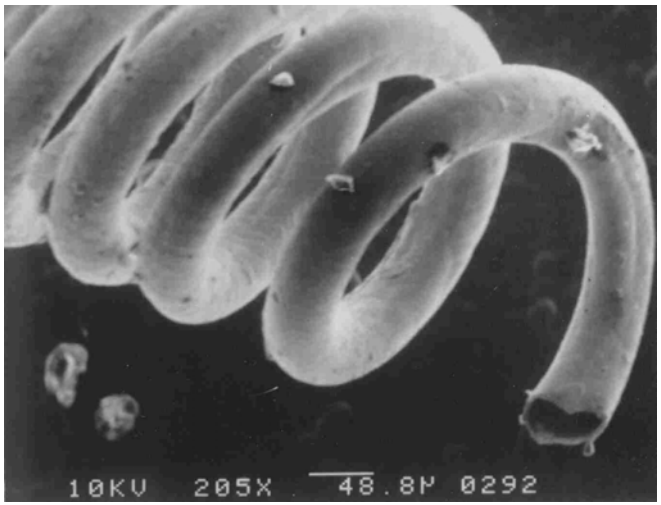
Control Axial and Cross-Sectional Dimensions

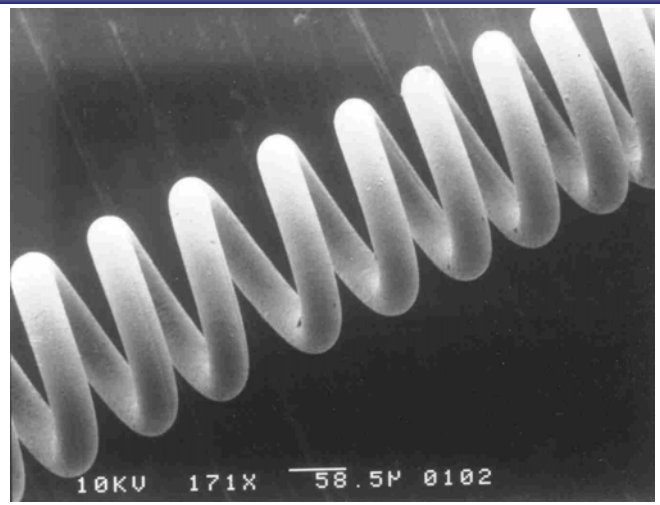




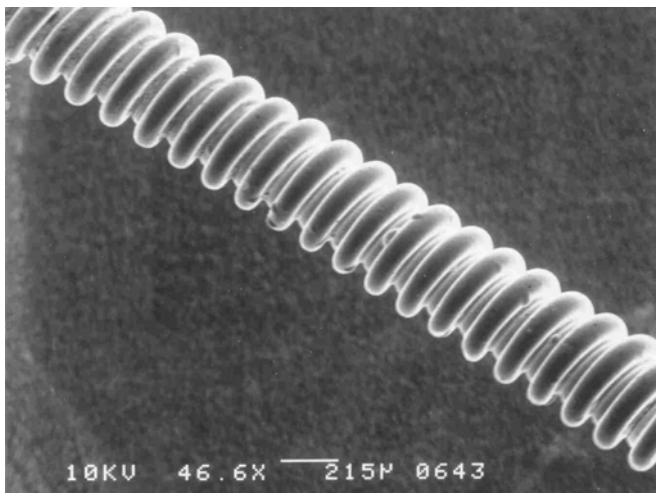
As can be seen with these discrete tubes both the axial and cross-sectional dimensions can be controlled to a fraction of a micron. The same is true if these tubes become channels in a solid part.

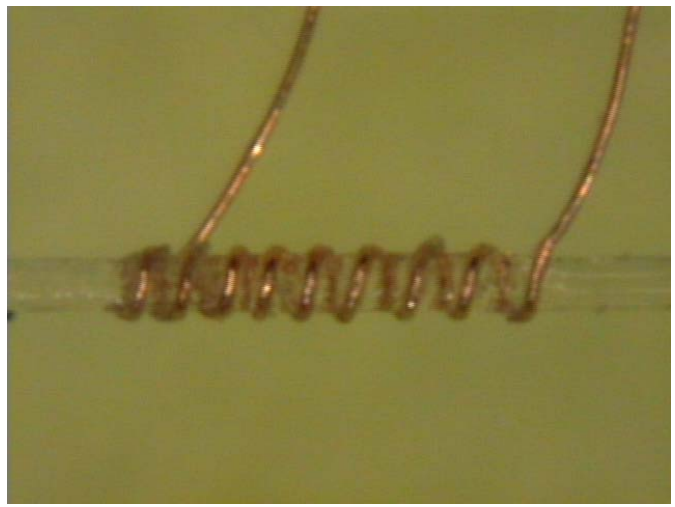
Tubes Can be Coiled in Many Ways



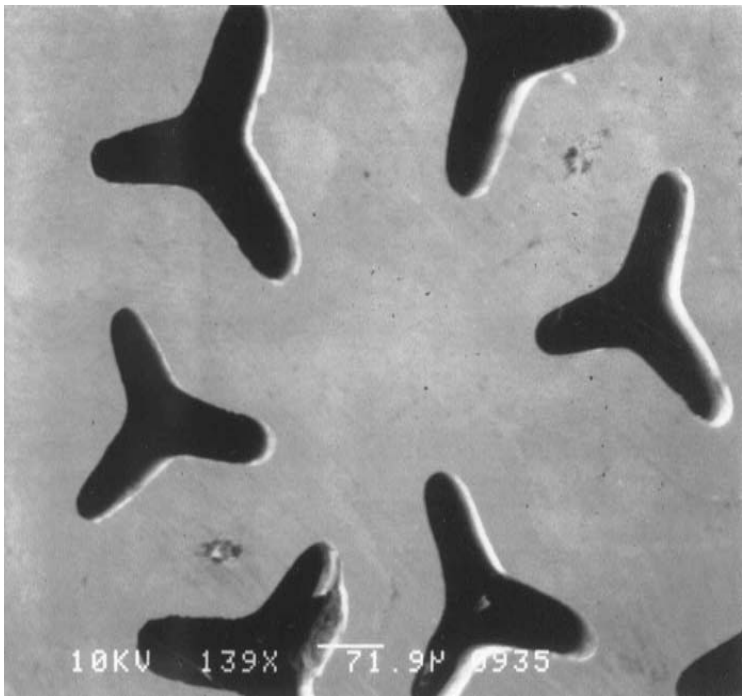


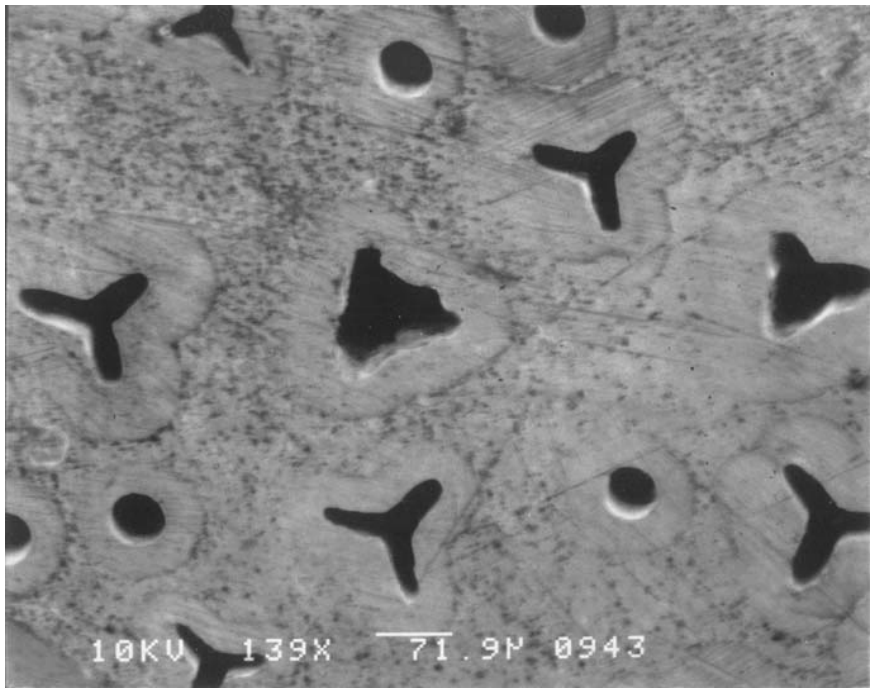
Tubes can be coiled individually or around one another.





Microtube Composites





The space between microtubes can be filled to produce monolithic bodies in which the microtubes form channels of desired orientation