

Powder-Based Work at Edwards AFB



Wesley P. Hoffman, Ph.D.
High Temp Components Group
Propulsion Directorate
Air Force Research Laboratory

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 29 APR 2004		2. REPORT TYPE		3. DATES COVERED -	
4. TITLE AND SUBTITLE Powder-Based Work at Edwards AFB				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Wes Hoffman				5d. PROJECT NUMBER 2306	
				5e. TASK NUMBER M1B3	
				5f. WORK UNIT NUMBER 2306M1B3	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC),AFRL/PRS,5 Pollux Drive,Edwards AFB,CA,93524-7048				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Bulk nanophasealuminum parts for aerospace and astronautics applicationsæMetallic coatings for microtubecomponents					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 10	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Areas of Interest

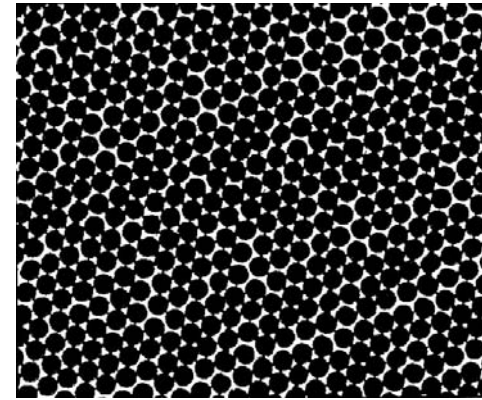


- Bulk nanophase aluminum parts for aerospace and astronautics applications
- Metallic coatings for microtube components

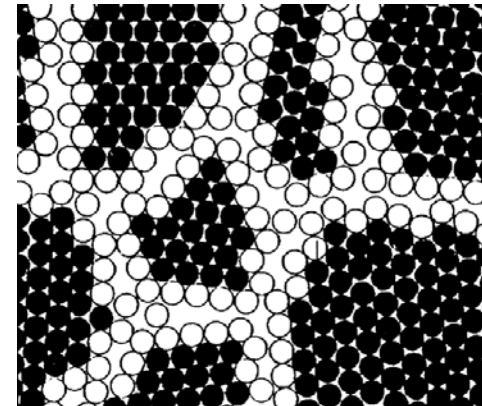


What are Nanocrystalline Materials?

- 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



Glove Box with Ar Atmosphere
w/ less than 1ppm O₂ and H₂O

Modified Ar Purification
System and Drying
System

Attrition System

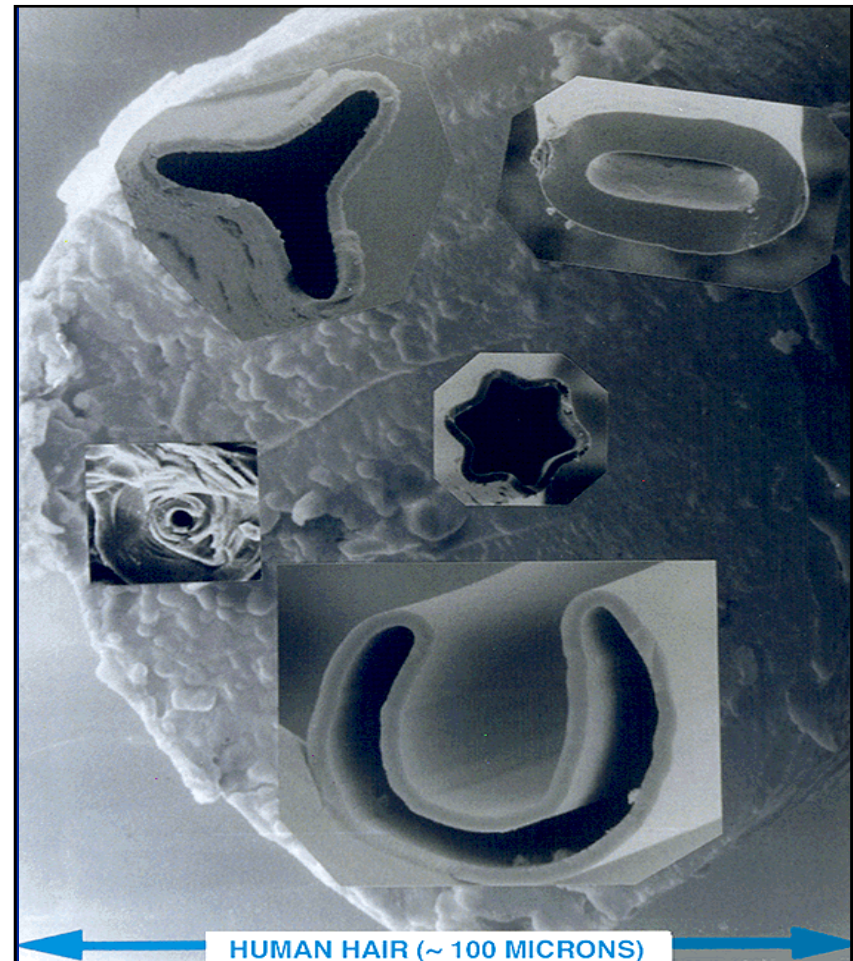


Microtubes and Microtube Composites



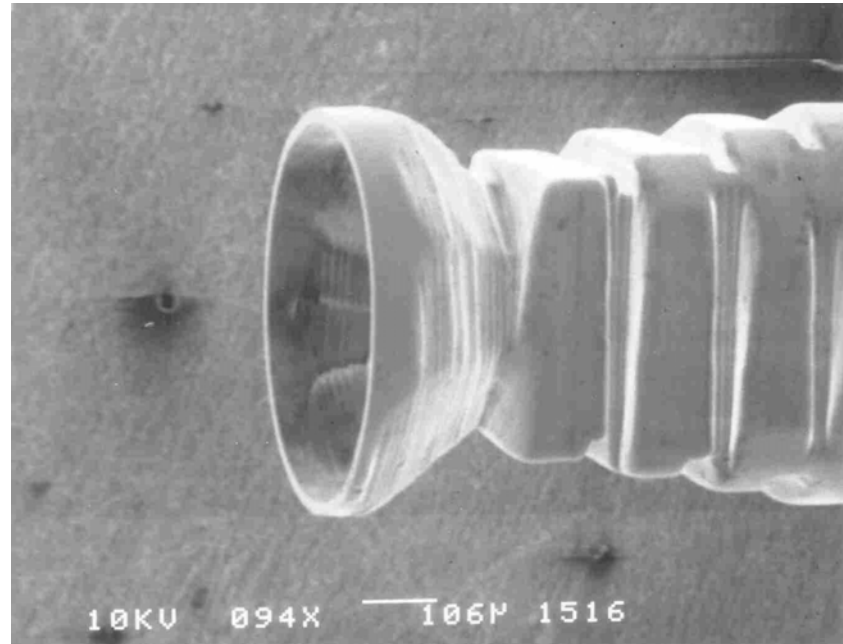
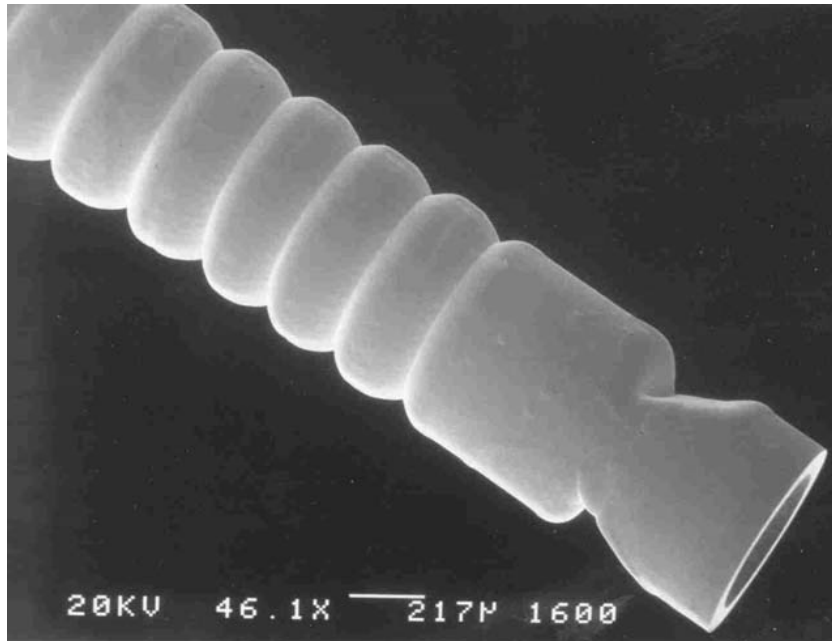
How many Microtubes
can Fit in a Human Hair?

(It Depends on How
Small You Make Them)





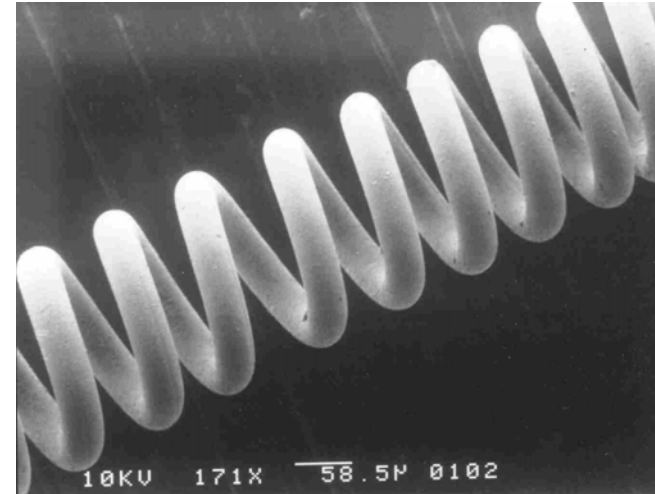
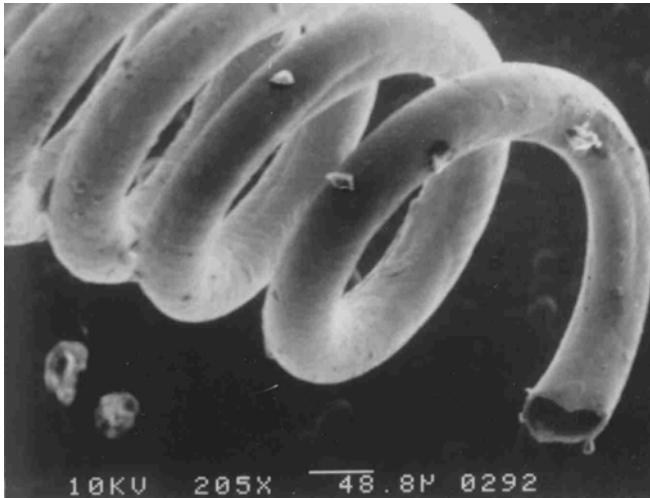
Control Axial and Cross-Sectional Dimensions



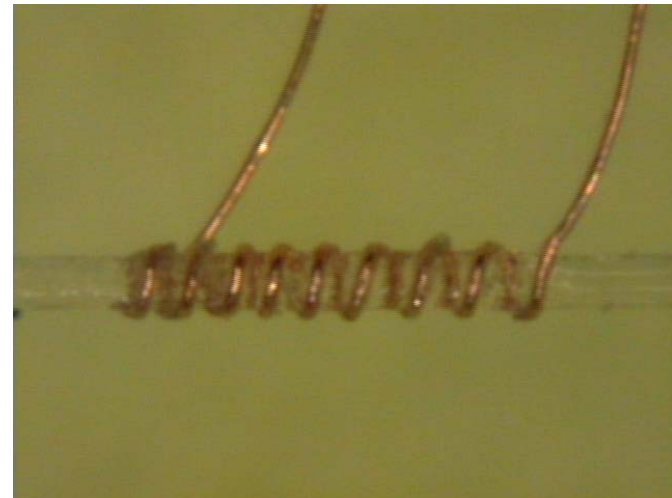
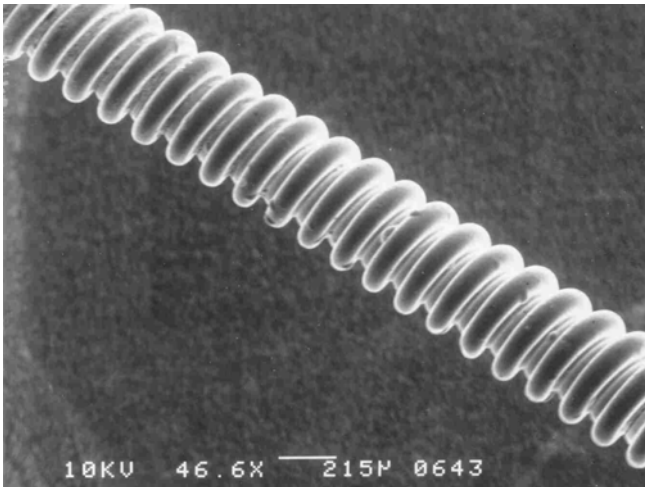
As can be seen with these discrete tubes both the axial and cross-sectional dimensions can be controlled to a fraction of a micron. The same is true if these tubes become channels in a solid part.



Tubes Can be Coiled in Many Ways

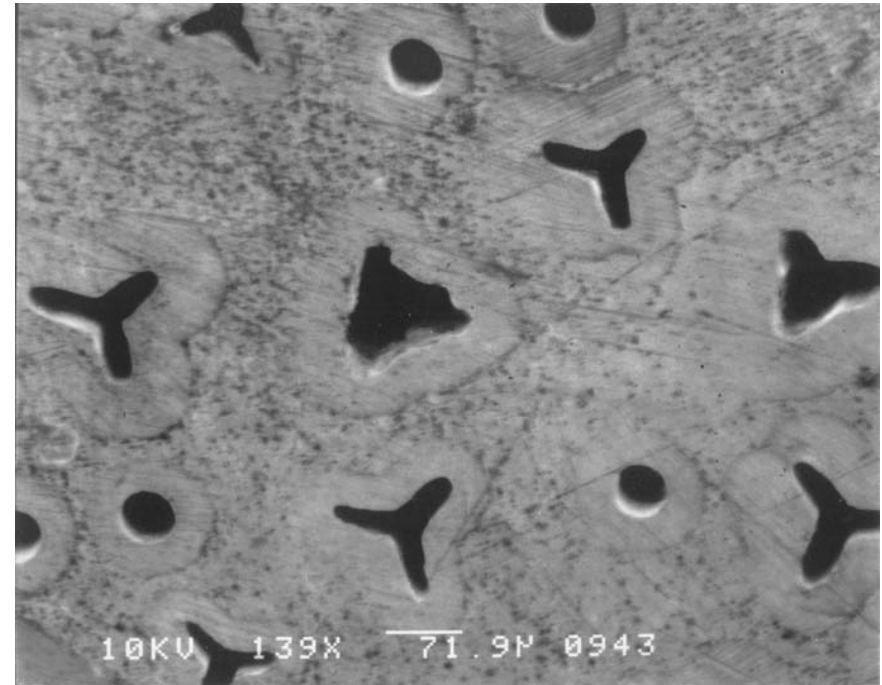
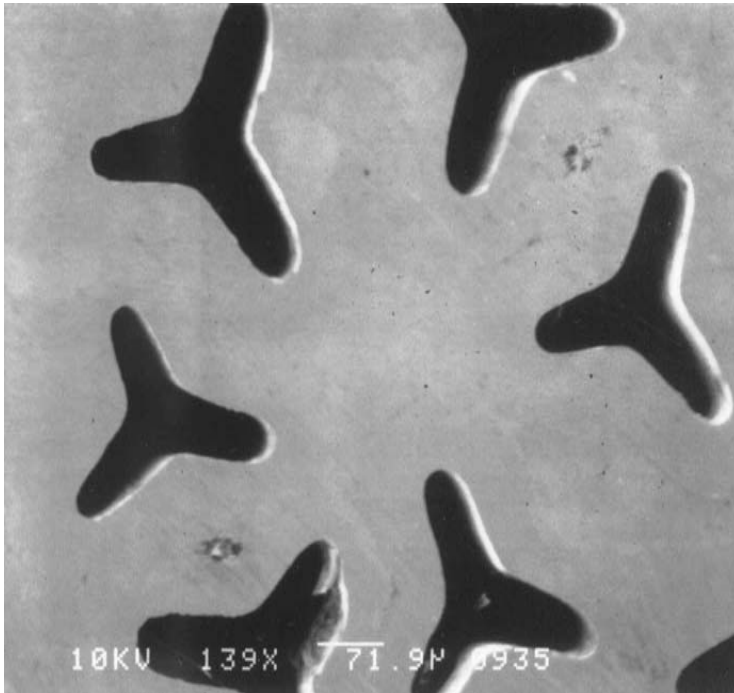


Tubes can be coiled individually or around one another.





Microtube Composites



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