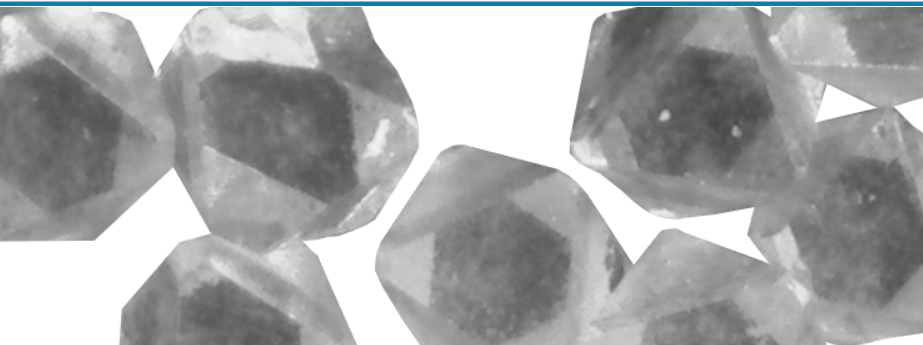


NANOMETER SIZE DIAMOND POWDERS, SOLUTIONS AND SLURRIES



World Leader in Superabrasive
Finishing Systems



The unique expertise developed in-house for the characterization of diamond powders with respect to particle size, particle shape, surface cleanliness, and purity (extrinsic & intrinsic impurities) enables Engis Corp. to manufacture consistently high-quality nanometer-size diamond powders whose properties are precisely defined and controlled for consistent performance.

DIAMOND TYPES & MANUFACTURING METHODS

Diamond type: Monocrystalline

- Static HPHT Synthesis
- Static compression of graphite-metal catalyst mixture at HPHT (P > 50 Kbar; T > 1400°C)

Diamond type: Engineered (Surface modified) Monocrystalline

- Modification of diamond surface via thermal processes (Amorphous Carbon surface layer/shell)

Diamond type: Polycrystalline

- Dynamic HPHT Synthesis – Indirect Explosion
- Shock wave compression of graphite-metal(Cu) mixture

Diamond type: Nanodiamond (Clusters of nano-size diamond nanocrystallites)

- Dynamic HPHT Synthesis – Direct Explosion
- Detonation of oxygen-deficient explosive mixture (TNT/RDX) in a closed chamber
- Laser treatment of targets containing carbon soot mixed within hydrocarbon media

NANOMETER SIZE DIAMOND POWDERS

- Size range: ~15 nm (N015) to ~950 nm (N950)
- Most nanometer-size diamond powders are produced as non-standard (customized) sizes & distributions upon customers' specific requirements.
- Nanodiamonds size range: ~15 nm (N015) to ~950 nm (N950)

TYPES

- Monocrystalline (metal bond) diamond: MA4 (N050 – N950)
- Engineered (surface-modified metal bond) diamond: EN4 (N050 – N950)
- Polycrystalline diamond: PC; PC4 (N025– N950)
- Nano crystallites diamond clusters: ND (N015 – N950)

APPLICATIONS

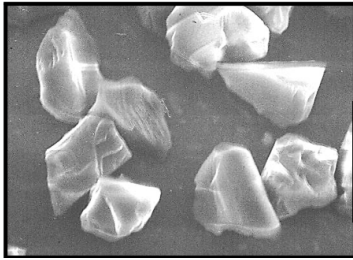
- Lapping & polishing: HDD, Optics, Electronics
- Medical: drug delivery and imaging systems
- Seeding for CVD Diamond Films
- Thermal management
- Coatings

By: Dr. Ion Benea

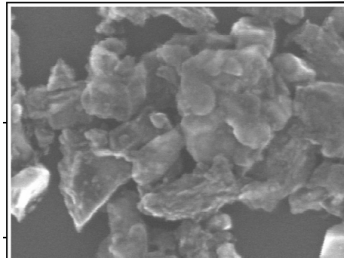
DIAMOND TYPES

SEM & FESEM Micrographs

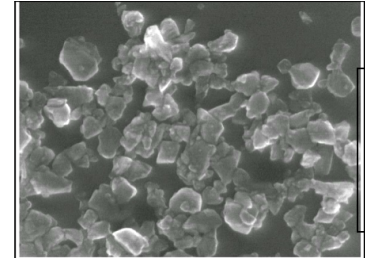
Metal bond MA4



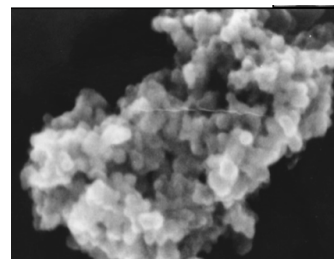
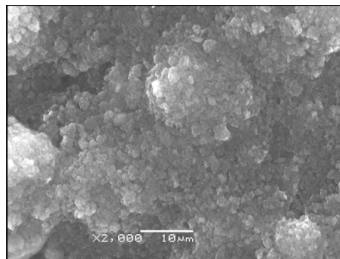
Polycrystalline PC; PC4



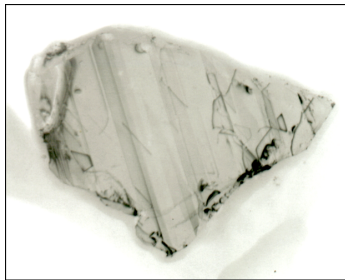
Metal bond (surface modified) EN4



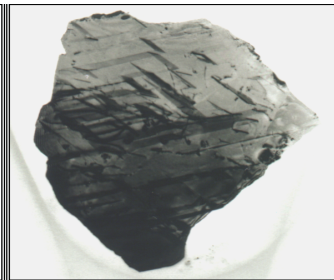
Nanodiamond (nano crystallite diamond clusters). ND



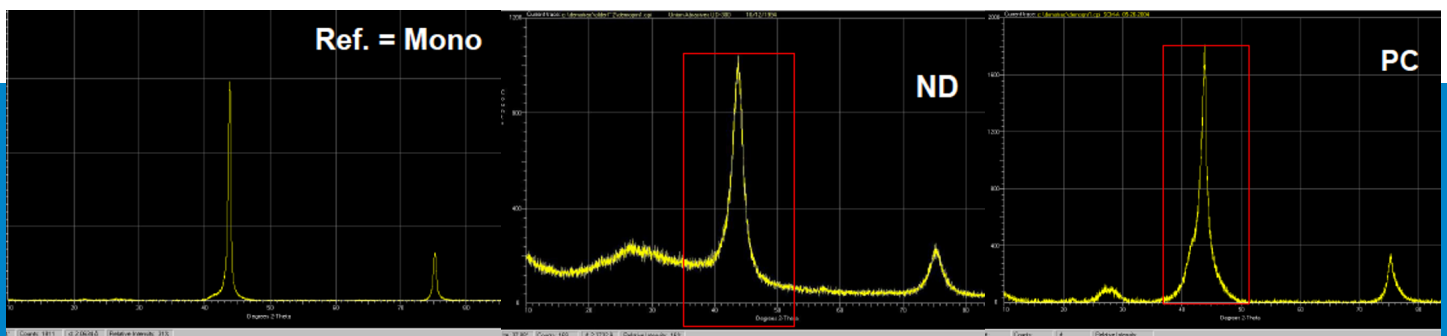
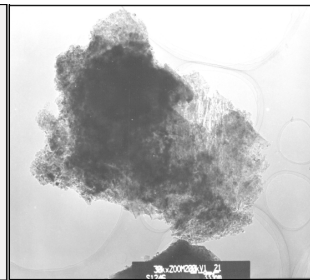
DIAMOND TYPES AND CRYSTALLINE STRUCTURE



Monocrystalline Diamond



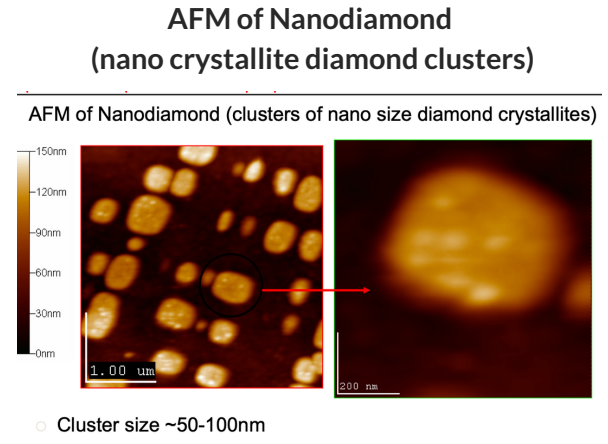
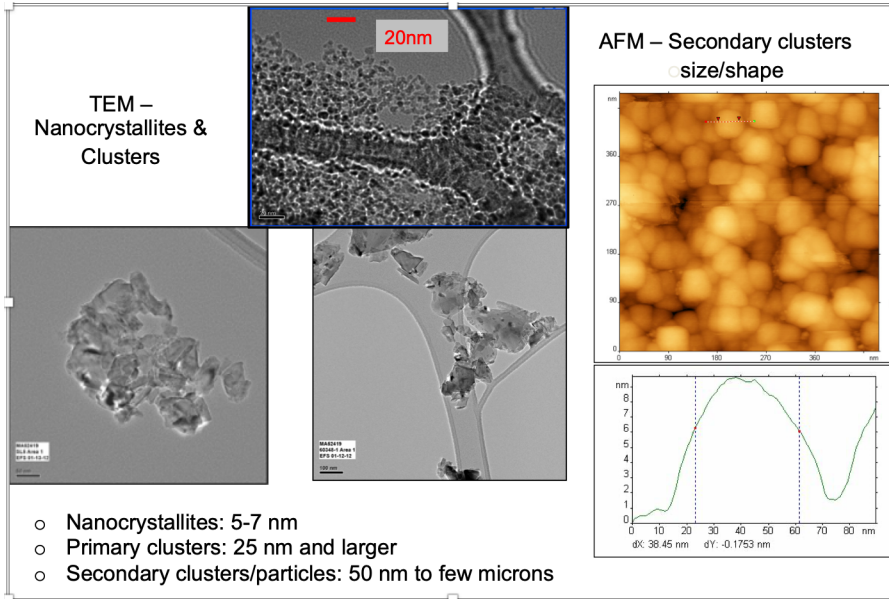
Engineered Surface Modified Monocrystalline Diamond



- Crystallite size is calculated from X-ray diffraction peak broadening using Full-Width Half Max (FWHM) of the peak at $2\theta = 43.84^\circ$
- Spectrum baseline smoothed
- Instrument broadening corrected with large particle size natural diamond.

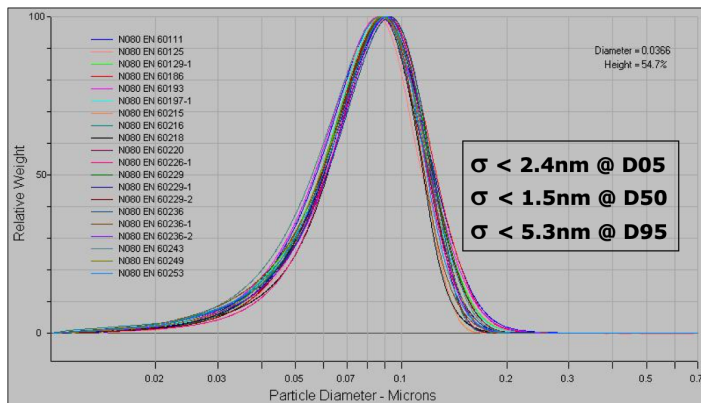
| Diamond Type | Typical Crystallite Size (nm) |
|----------------------|-------------------------------|
| Monocrystalline (MA) | 46.53 |
| Polycrystalline (PC) | 23.90 |
| nanodiamond (ND) | 5.22 |

NANODIAMOND / NANO CRYSTALLITES DIAMOND CLUSTERS

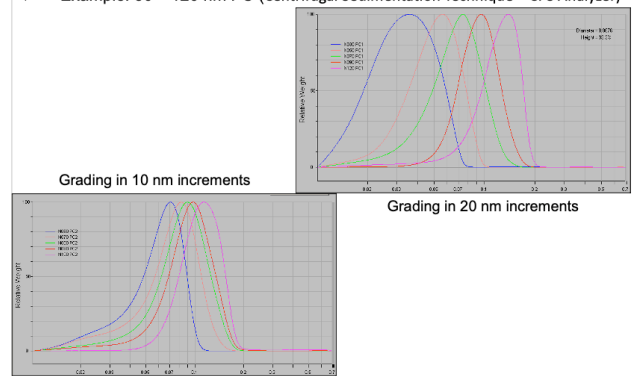


Grading Capability - Consistency & Resolution

Example: N080 EN4 (Centrifugal Sedimentation Technique – CPS Analyzer)

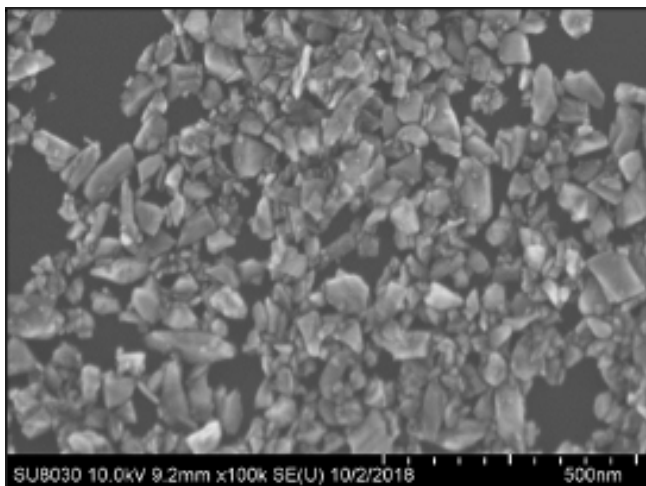


Example: 30 – 120 nm PC (Centrifugal Sedimentation Technique – CPS Analyzer)



Fesem - 40 nm Diamond

N040 EN4



N040 EN4 - coated with Au/Pd

