

## Seeding Slurries

Since its development in the 1980s, Chemical Vapor Deposition (CVD) growth of thin film diamond has found an abundance of use in the microelectronic and tooling industries. Whether the incredible dielectric properties or mechanical properties of diamond are desired, Adámas's patented seeding slurries offer the core particles required to grown dense, defect-free films of thin diamond on both 2D and 3D substrates, utilizing detonation synthesized nanodiamonds.

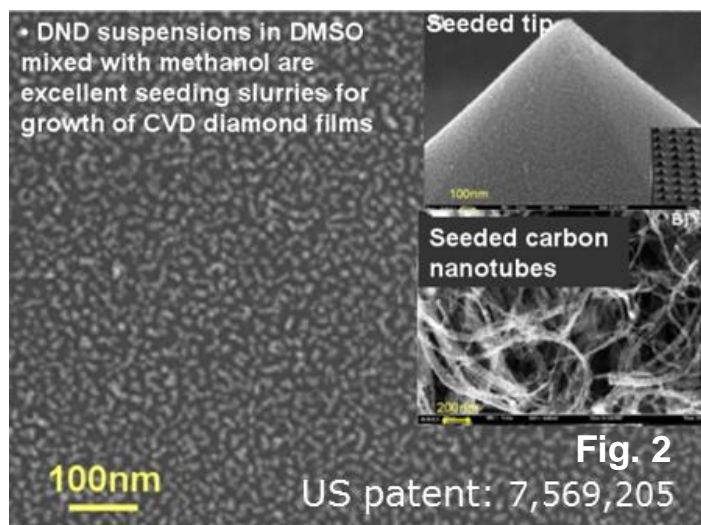
### Content At a Glance:

This document provides general characteristics of the featured product series to provide you with the necessary information to make a more informed purchase.

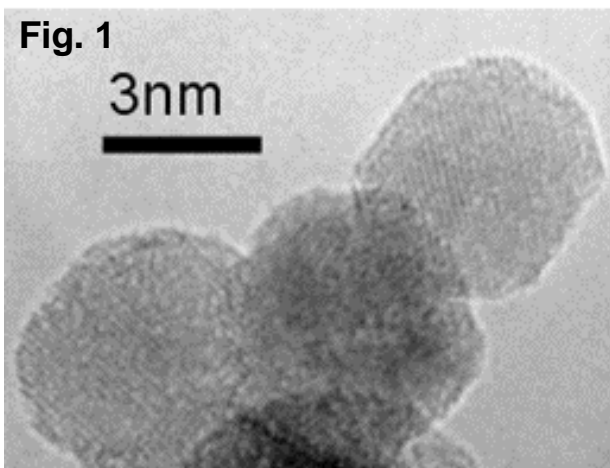
- General characterization two seeding slurry product lines: Opalseeds and Blueseeds
- Characteristics include: Particle size distributions (dynamic light scattering) and zeta potential
- Baseline seeding procedure for silicon wafers.

### Blueseeds (5-10nm Seeds)

Blueseeds are the smallest available seeding diamond crystals on the market. These seeds consist of fully deagglomerated primary particles of detonation nanodiamonds. These 4-5nm, largely spherical, diamond crystals, offer the highest seeding density, and will nucleate to form a higher density of small grains, providing a higher strength and more wear-resistant film. Blueseeds are available in amounts ranging from 200mL to 3L.



**Fig. 2:** Various substrates seeded using detonation nanodiamonds (NDs) slurries. Substrates include a silicon wafer (2D substrate), a field tip array (3D), and ND coated carbon nanotubes.

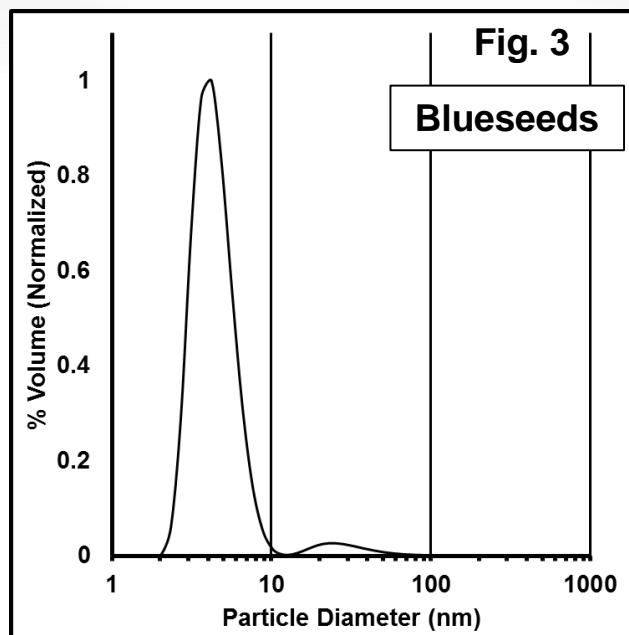


**Fig. 1:** High Resolution TEM (HRTEM) of primary particles of detonation nanodiamonds.

Product	Catalogue No.
Blueseeds	BlueSeeds200ml
	BlueSeeds400ml
	BlueSeeds1L
	Blueseeds3L

Blueseeds are sold as 5 mg/mL concentrates in dimethyl sulfoxide (DMSO). These concentrates can be diluted with methanol at the customer's site before subsequently being used for substrate seeding. The surface chemistry of the diamond particles is amphoteric (consisting of alcohols, carboxyls, ketones, etc.), but the particles exhibit a positive zeta potential (>+30mV) in water, meaning they are particularly effective at seeding negatively charged substrates, such as silicon dioxide.

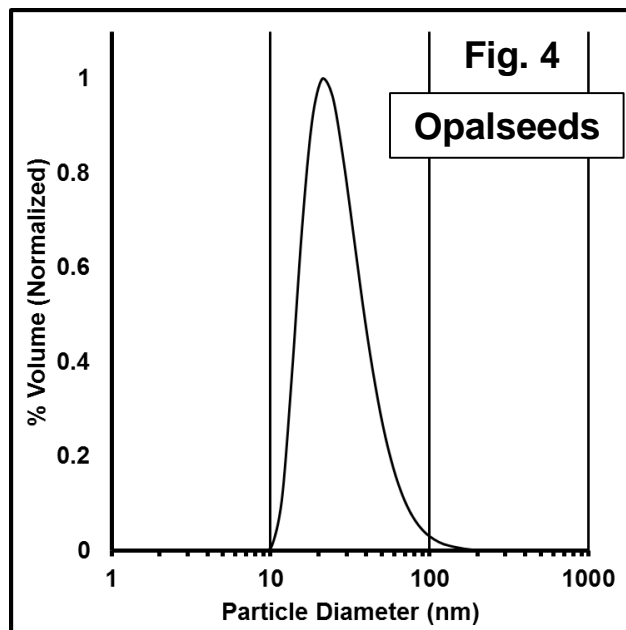
**Fig. 3:** Particle size distribution of Blueseeds measured using dynamic light scattering (DLS). Malvern Instruments Nano ZS.



### Opalseeds (20-30nm Seeds)

Opalseeds, like Blueseeds, originate from detonation synthesized diamond; however, unlike Blueseeds, Opalseeds consist of 20-30nm aggregates of the 4-5nm primary particles. Opalseeds offer a cheaper alternative to Blueseeds, but still provide a high quality of seeding which has been more than sufficient for a number of customers. Like Blueseeds, Opalseeds also exhibit a positive zeta potential which is best suited for negatively charged surfaces, and are sold as 5 mg/mL suspensions in dimethyl sulfoxide.

Product	Catalogue No.
Opalseeds	OpalSeeds200ml
	OpalSeeds400ml
	OpalSeeds1L
	Opalseeds3L



**Fig. 4:** Particle size distribution of Opalseeds measured using dynamic light scattering (DLS). Malvern Instruments Nano ZS.

### Introduction to Seeding

A standard procedure for seeding of a silicon wafer is outlined below. Customers should only use this as a guideline for process development, since different types of substrates can lead to different results.

#### (1) Preparation of Seeding Slurry:

- 1 part of 5 mg/mL (0.5% w/v) seeding slurry is mixed with 3 parts of methanol. The mixture should be thoroughly mixed.
- (Optional) It is recommended that a probe tip ultrasonic horn is used to homogenize the mixture, though this is not required.

#### (2) Preparation of Substrate:

- A standard cleaning process such as the SC1 or RCA clean process can be used to remove organic contaminants from the substrate.

**NOTE: This procedure is meant to serve as a baseline for new customers. The substrate can play a role in seeding density. The above procedure was developed on silicon. Customers are encouraged to develop their own procedures in house.**

#### (3) Ultrasonic Seeding:

- After thorough cleaning of the substrate, it should be submerged into a solution of the seeding slurry such that at least 5 mm of the slurry is above the surface of the substrate. 15 minutes of ultrasonic treatment is sufficient for effective seeding.

#### (4) Post Seeding Rinse:

- After seeding, the substrate should be removed from the seeding slurry and ultrasonic bath, rinsed with methanol, and dried with inert gas or clean compressed air. The substrate is now ready for deposition growth of thin film diamond.



*DISCLAIMER: Product characteristics, specifications, costs, part numbers, and all other details are accurate as of the date of preparation of this document. These values are subject to change. Product characteristics are subject to batch to batch variability and improvements in processing or other developments.*

### FEATURED PRODUCTS

Category	Product	Sold As*	Catalogue No.	Price
5-10nm Seeds	Blueseeds	5 mg/mL (0.5% w/v) in Dimethyl Sulfoxide (DMSO)	BlueSeeds200ml	\$395.00
			BlueSeeds400ml	\$595.00
			BlueSeeds1L	\$1,100.00
			Blueseeds3L	\$3,000.00
20-30nm Seeds	Opalseeds	5 mg/mL (0.5% w/v) in Dimethyl Sulfoxide (DMSO)	OpalSeeds200ml	\$295.00
			OpalSeeds400ml	\$495.00
			OpalSeeds1L	\$950.00
			Opalseeds3L	\$2,700.00

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