ADVANCED DIAMOND TECHNOLOGIES, INC.

UNCD® Wafers—Diamond within Reach

Thin, smooth diamond for wafer-scale integration

Diamond is the ultimate MEMS, electronic and mechanical substrate, combining bulk and surface properties unmatched by any other material. Until now, however, it has been impossible to capture the properties of diamond in thin film form suitable for wafer-based applications with the levels of reliability and reproducibility demanded by the semiconductor industry. Advanced Diamond Technologies (ADT) offers diamond thin-film products enabling industry to leverage and integrate the advantages of diamond.

UNCD Aqua Series

The UNCD® Aqua series of wafers are phase-pure nanocrystalline diamond films. UNCD differs from other nanocrystalline diamond films in that other films are typically comprised of graphitically-bonded material intermixed with crystalline diamond grains. UNCD, in contrast, has no amorphous or graphitic phases. The results are films that capture the hardness, modulus, and other extreme properties of natural diamond but which are also smooth and have very low internal stresses.

The UNCD Aqua series of wafers provides a range of properties that enables optimization for a given application, as illustrated in the table below. While all UNCD products leverage the benefits of diamond, Aqua series of wafers are engineered to accentuate diamond properties, allowing the designer to tailor the UNCD solution to the application— ◆ good, ◆◆ better, ◆◆◆ best.

		UNCD Solution		
Property	**Applications**	**Aqua 25**	**Aqua 50**	**Aqua 100**
Mirror-smooth surface	Low stiction coatings, MEMS, AFM probes, and RF electronics	◆◆◆	◆◆	◆
High thermal conductivity	Heat spreader and thermal management	◆	◆◆	◆◆◆
Corrosion resistance	Electrochemical electrodes, food & pharmaceutical processing	◆◆◆	◆◆◆	◆◆◆
Optical transparency	Wear resistant optical coatings and windows of diamond thin film	◆	◆◆	◆◆◆
Low friction and wear resistance	Mechanical seals and bearings	◆◆◆	◆◆◆	◆◆◆
Biocompatibility	Orthopedic implants	◆◆◆	◆◆	◆◆
Foundry compatibility and minimal wafer bow	Mass MEMS production, cold cathode devices, and field emitter arrays	◆◆◆	◆◆◆	◆◆◆

UNCD AFM probe made from DOI Wafer

Why Diamond for MEMS?

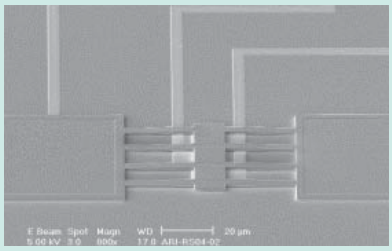
Diamond has unsurpassed bulk and surface properties that exceed those of any other material. Most MEMS devices are based on silicon because of the availability of microfabrication techniques developed for the integrated circuits industry. Compared to silicon, however, diamond's extreme properties outperform it for MEMS applications, and diamond can be easily micromachined using reactive ion etching (RIE).

Patterned DoSi Wafer

www.thindiamond.com

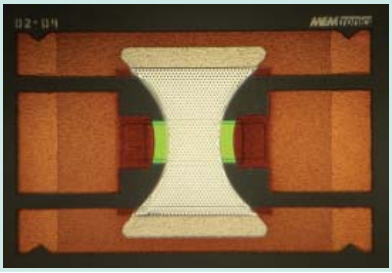
UNCD® Wafers—Diamond within Reach

Examples of UNCD in MEMS Devices



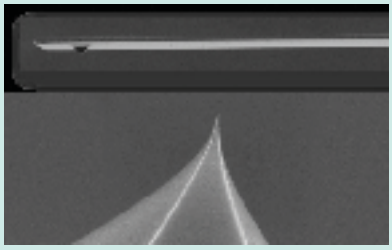
RF MEMS Resonator

MEMS resonator made using UNCD DoSi wafers, photo courtesy of Innovative Micro Technology (IMT), Santa Barbara, CA.



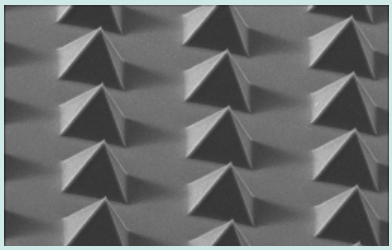
RF MEMS Switch

MEMS switch made using UNCD Aqua 25 as the low-trap dielectric. Created in collaboration with MEMtronics Corporation, this switch achieved over one billion cycles in dry air.



AFM Probes

Monolithic diamond AFM cantilever probes, NaDiaProbes™, made entirely of UNCD. NaDiaProbes will soon be commercially available from ADT. Tip radii as small as 10 nm are achievable.



Molded 3D Structures

Complex 3D structures, such as this tip array, were created using a combination of molds and UNCD deposition in a wafer-scale process.

DoSi™ Wafers—Diamond on Silicon

DoSi wafers consist of UNCD Aqua varieties deposited directly on silicon wafers. Wafers are available in sizes of 100, 150, and 200 mm. UNCD wafers are excellent for starting MEMS device development with diamond.

UNCD DOI™ Wafers—Diamond on Insulator

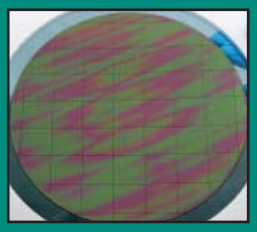
DOI wafers consist of UNCD Aqua films deposited on standard silicon wafers that are first coated with a thermal oxide layer. These wafers meet baseline wafer-level specifications for thickness, property uniformity, wafer bow, and particle counts suitable for direct insertion into a MEMS foundry process sequence. DOI wafers are available in a variety of wafer sizes.

Visit www.thindiamond.com to order UNCD DoSi and DOI wafers.

UNCD®

ADT's UNCD is synthesized in thin-film form using a patented method and is comprised of diamond grains that can be as small as about 5 nm in diameter—a billion-fold smaller in volume than in traditional diamond films.

UNCD has many of the desirable characteristics of diamond such as hardness, modulus and fracture toughness. Because of UNCD's hardness, monolithic UNCD AFM probes, known as NaDiaProbes, resist deformation which enhances resolution and increases probe lifetimes. UNCD also has diamond's exceptional surface properties of low friction and stiction for use as a wear coating and for superior all-around performance.



UNCD DoSi Wafer, diced

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