Thin, Smooth Diamond for Breakthrough Solutions

Advanced Diamond Technologies (ADT) harnesses the extreme properties of nature's perfect material by turning natural gas into diamond in a highly controlled, reproducible process for a variety of industrial, environmental, electronics and biomedical applications. ADT offers several families of high performance UNCD® products that take advantage of the unsurpassed properties of diamond.

Enabling Innovation in: Industrial • Environmental • Electronics • Biomedical
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Known for its ability to seamlessly integrate with other materials, UNCD is mirror-smooth. Since it is vapor deposited, UNCD can be used to bring the properties of diamond to existing products while enabling entirely new classes of high performance devices. With the advances brought about by UNCD, diamond can now be considered by engineers during the design phase from their palette of materials to enable entirely new classes of applications. Thin film diamond has graduated from the laboratory to become a genuine industrial material whose properties and performance characteristics can be characterized and reproduced. What is not widely understood is that the properties of these films can be tuned over a very broad range. Like steel or aluminum alloys which are optimized for particular applications, the properties of thin film diamond can also be adjusted in a controllable and reproducible manner.

ADT’s products and solutions are not defined by simply looking at a market and determining how a step improvement in design can continuously beat the competition and yet not fall into a commoditized class of product. Rather, the ADT team considers both the market and technology opportunity, and determines how a novel UNCD application can enable unparalleled performance benefits (most often previously unachievable) and provide breakthrough differentiation for our strategic partners.

At ADT our mission is to be the leader in delivering the value of thin, smooth diamond, based on UNCD technology, creating and commercializing breakthrough products to industrial, environmental, electronics, and biomedical markets.
NaDiaProbes

NaDiaProbes are all-diamond AFM probes - not diamond coated or diamond-like carbon. Both the cantilever and probe tip are made of UNCD (ADT’s brand of thin, film diamond) in a single, monolithic structure and demonstrate the astonishing control and precision that is available with diamond today.

Offered in both our ND (less than 50 nm tip radius) and AD (less than 10 nm tip radius), ADT has an all-diamond AFM probe to fill your application needs:

**Dynamic (Non-Contact) Mode Probes**
- Dynamic mode topographic imaging
- Surface potential imaging
- Nanoindentation

**Conductive Diamond Probes**
- c-AFM
- Scanning Spreading Resistance Microscopy (SSRM)
- Oxidation Nanolithography
- E-Chem AFM
- Piezo-Force Microscopy

**Contact Mode Probes**
- Scanning hard surfaces
- Quality control for production
- Nanomanufacturing

**UNCD Wafers**

UNCD Wafers are wafer-scale products, used for exploiting the vast potential of diamond materials such as MEMS development, tribological testing, and unique nano-scale processing applications. UNCD Wafers offer the ability to create and experiment with the extraordinary properties of diamond, using the award winning family of UNCD materials. UNCD Wafers meet a set of baseline wafer-level specifications for thickness, property uniformity, wafer bow, and target thicknesses suitable for direct insertion into a MEMS foundry process sequence.

If your application is novel and the standard UNCD Wafers do not match your requirements, please contact us and we can apply our diamond expertise to a unique solution that fits your specifications and budget.

**Aqua 25:** Universal diamond film, electrically insulating, small grain size (3-5nm), smooth (<10nm rms)

**Lightning:** Electrically conductive diamond, small grain size (3-5nm), smooth (<10nm rms)

**Horizon:** Polished Aqua 25, ultra-smooth (<1nm rms)

**Thermal/Aqua 100:** Largest Grain size (>1um), greatest thermally conductivity of all our products

**UNCD Devices**

Using UNCD to enable RF MEMS devices enables greater frequency diversity (‘super WiFi’) for next-generation mobile wireless broadband.

Switch fabricated using UNCD Aqua 25 as the low-trap dielectric (i.e., the green area in the center of the switch). This switch achieved 1 billion cycles in dry air.

**Thermal**
- Creates a heat pipe from the junction to a sink
- Thermal diamond (UNCD)
- >500 W/mK
- Multiple integration pathways
On-Site Generation (OSG) of oxidants for water treatment is based on the electrolysis of brines to produce chemicals that are typically used for the disinfection of water. These chemicals include chlorine (hypochlorous acid + hypochlorite), bromate, persulfate, ozone, hydrogen peroxide, percarbonate, and others. Instead of transporting and storing these hazardous chemicals at the point of application, OSG produces them on-site using only water, salt, and energy. This can lower the costs of water treatment, while also achieving better disinfection performance which also creates a safer work environment. OSG benefits society in general by reducing the energy costs and national security risks.

In the past, the adoption of OSG has been hindered by the general lack of robustness of the technology. Diamonox® solves this problem by enabling OSG system design to be simplified dramatically while at the same time boosting the technology’s performance. Through the combination of improved efficiency, mixed oxidant performance, reduce maintenance costs and longer electrode life, Diamonox can achieve lower operating costs and return-on-investment (ROI) metrics unreachable with other technologies. It also enable OSG to be used in situations where currently the technology simply cannot be applied due to problems with water quality or higher raw materials costs.

**Diamonox Cells & Systems**

**On-Site Generation of Oxidants (OSG)**

- Mixed Oxidants
- Hypochlorite
- Persulfate (peroxodisulfate)
- Ozone
- Hypobromite

**Electrochemical Advanced Oxidation Process**

- Hydroxyl radicals high efficiency destruction of organic waste
- COD reduction in industry waste water

**Chemical and Biological Sensors**

- Ampermetric detection of redox-active contaminants
UNCD for Bio Applications

- UNCD surfaces are ideal sensor platforms for highly reliable, reproducible, sensitive and selective bio detection
- UNCD’s unique chemical inertness and surface stability provides continuous, long-term in-vitro and in-vivo monitoring
- An electrochemical model for bio functionalized, UNCD microarrays could lead to better understanding of the impedance detection mechanism
- Validation of circuit elements to reduce the need for control experiments is in progress
- UNCD’s patterning capabilities position this multiplexed sensor technology for rapid adoption in point-of-use diagnostics

A robust biosensor platform for highly multiplexed, label-free, sensitive and selective detection

- Extremely stable - chemical, thermal, structural (High S/N ratio)
- Biocompatible, bio inert, corrosion resistant
- High resistance to surface fouling
- Long-term stability of tethered biomolecules
- High reusability (multiple regeneration cycles)
- Tunable microstructure / surface properties
- Extremely conformal coating
- Ultra-smooth surface (10nm rms)
- Low background noise and wide potential window
- Low cost due to less material (sub-micron thick films)
UNCD Components bring the tribological benefits of diamond to mechanical seals and hydrodynamic bearings used for rotary equipment, such as pumps and mixers. UNCD Components are processed using ADT’s patented diamond technology and enhance reliability, increase energy efficiency and provide the ability to survive dry running in the most hostile of rotating equipment environments.

**UNCD Components**

- Longer lasting seals in demanding applications
- More resistant to dry and poor lubricating environments
- Enables the use of hard faces in applications where dry running can occur
- Reduced energy consumption
- Suitable for a wide range of media

**UNCD Faces**

UNCD Faces outperform SiC faces in extreme wear tests. After thousands of hours of operation, UNCD Faces have consistently outlasted SiC faces in poor lubricating conditions of 250-300 °F hot water. In head-to-head industrial tests, UNCD Faces have shown negligible or minimal wear whereas SiC faces experienced deep grooving resulting in pump leakage. UNCD Faces have also been shown, when running against SiC, to have coefficients of friction (CoF) of 0.02-0.04. These are well below the typical values when running SiC in hard-on-hard applications.

Advanced Diamond Technologies offers a choice of UNCD products to cover a range of mechanical seal and bearing applications. UNCD T10™ and T30™ are specifically engineered for mechanical seals for fluid pumps, while UNCD T90™ is appropriate for hydrodynamic bearing applications.

**Service Requirements**

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<th>Requirement</th>
<th>T10™</th>
<th>T30™</th>
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<tr>
<td>Intermittent Dry Running</td>
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**Below:**

UNCD films on SiC faces & bearings