OVERVIEW

The Fraunhofer Center for Coatings and Diamond Technologies (CCD) is your partner of choice when it comes to advanced carbon materials. CCD offers professional research services based on chemical and physical vapor deposition (CVD/PVD) of carbon thin films including diamond-like carbons and diamond. Customers benefit from access to state-of-the-art equipment, process development and consulting services.

ADVANCED CARBON MATERIALS

CCD offers material synthesis know-how and solutions based on the following material groups:

- Single crystalline diamond (SCD)
- Polycrystalline diamond (PCD)
- Nanocrystalline diamond (NCD)
- Boron-doped diamond (BDD)
- Diamond-like carbon (DLC)

CCD OFFER

CCD’s expertise in CVD and PVD reactor design, carbon-based process and materials development is offered to our customers to improve existing and to create entirely new products. Typical services include:

- Materials synthesis (e.g. thin film deposition of carbon films and fabrication freestanding carbon materials)
- Materials processing (e.g. laser micromachining, microfabrication of carbon structures through lithography and plasma etching)
- Materials characterization
- Integration of carbon materials in devices and systems
- Manufacturing process development
- Product development
- Reactor design
- Consulting
CARBON MATERIALS SYNTHESIS

Diamond materials synthesis is accomplished using the latest in-house developed chemical vapor deposition reactor technology. A specialty is the synthesis of n- and p-typed doped single crystalline diamond materials for sensor and electronic applications. Dedicated reactors for boron and phosphorous doping are available.

Diamor® is Fraunhofer’s own diamond-like carbon material, which is characterized by extreme hardness, durability and low-friction properties. The coating is designed for wear resistant applications in the automotive, tooling and medical device industries and can be tailored to specific customer requirements. Diamor® is based on tetrahedral amorphous carbon (ta-C) and is also available in doped varieties such as ta-C:H, ta-C:F, ta-C:N and ta-C:Me.

MATERIALS PROCESSING

Offering solutions to our customers implies the capability to process the synthesized carbon materials. For example, integrating a diamond crystal into an optical device requires polishing and shaping of the crystal to achieve the desired results. To this end CCD has established a number of very specialized materials processing techniques that are applied during product development and fabrication to incorporate diamond and amorphous carbon films as engineered materials. Processing capabilities include:

- Laser cutting and micromachining
- Plasma activation and etching
- Wet chemical etching
- Chemical mechanical polishing (CMP) & lapping
- Microfabrication process flows including lithography
- Anti-reflective (AR) coatings
- Hydrophobic and hydrophilic surface coatings

CHARACTERIZATION

Analyzing synthesized materials is critical to ensure product performance. CCD offers a wide array of analysis and characterization measurements and techniques for carbon materials including:

- Hall measurements of charge carrier mobilities
- UV-Vis and IR spectroscopy
- Raman spectroscopy
- Birefringence measurements
- Scanning electron microscopy (SEM) including energy-dispersive X-Ray spectroscopy (EDX) for chemical analysis
- X-ray diffraction (XRD)
- X-ray photon spectroscopy (XPS)
- Electrochemical analysis
- Sheet resistance measurements
- Young’s modulus measurements
- Surface roughness measurements
- Wear volume and coefficient of friction (dry and lubricated)
- Thin film adhesion quantification
- Contact angle measurements
- Thin film thickness measurements

APPLICATIONS

- Diamond electronics
- Diamond optical crystals (e.g. ATR crystals)
- High power diamond windows
- Diamond foils (1-50 µm thick)
- Diamond coated wafers
- Boron doped diamond (BDD) electrodes for electrochemical applications
- BDD microelectrodes and micro-electrode arrays
- Diamond for MEMS devices
- Diamond and Diamor® coatings for implants
- Diamond or Diamor® coated atomic force microscope tips
- Transparent Diamor® coatings
- Hydrophobic and hydrophilic Diamor® coatings
- Diamor® coatings for wear parts and engine components
- Diamor® coatings for cutting tools