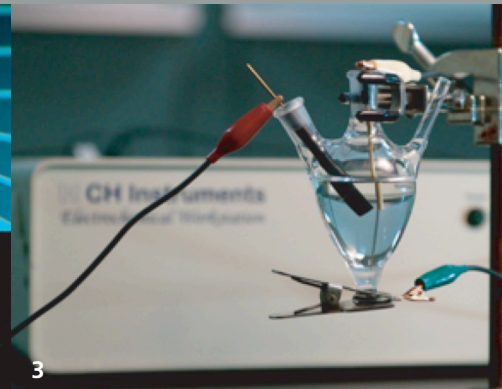
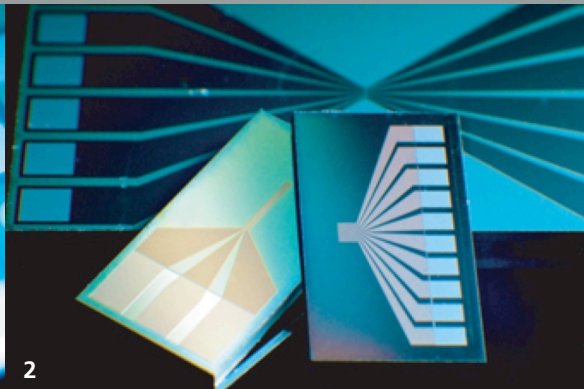




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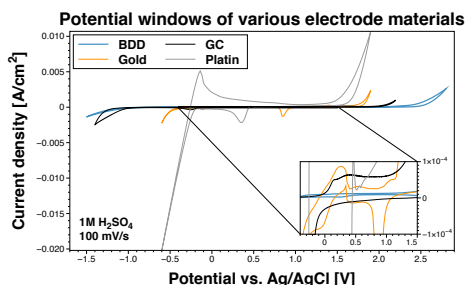
USA

CENTER FOR COATINGS AND DIAMOND TECHNOLOGIES



BORON DOPED DIAMOND

Boron Doped Diamond Products



BORON-DOPED DIAMOND

Boron-doped diamond (BDD) is an excellent electrode material with superior material characteristics. BDD has the largest electrochemical potential window in aqueous solutions compared to traditional electrode materials such as gold, platinum and glassy carbon. Chemical reactions that occur within the electric potential range from -1.2 V to +2.5 V can be investigated.

BDD has a characteristically low and featureless background current resulting in higher sensitivity and improved detection limits. In addition the material also features extreme chemical stability, which makes BDD electrodes last longer in aggressive environments. BDD is optically transparent, mechanical robust and biocompatible. It is a suitable electrode material for many applications including:

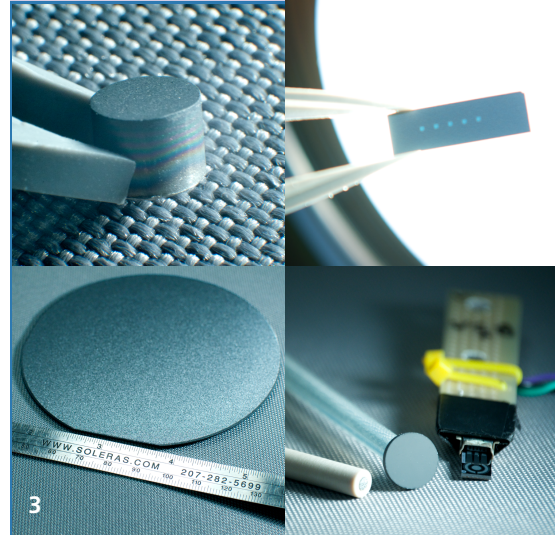
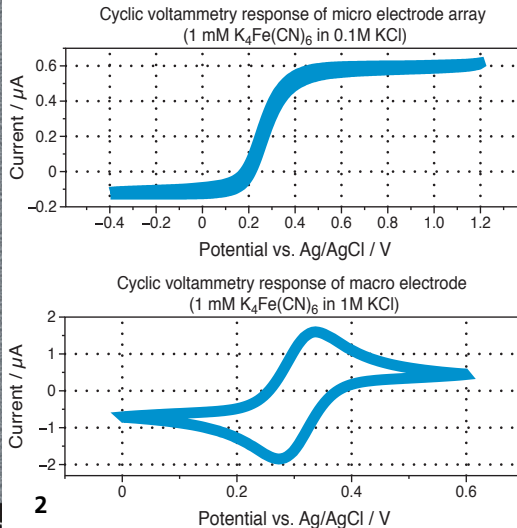
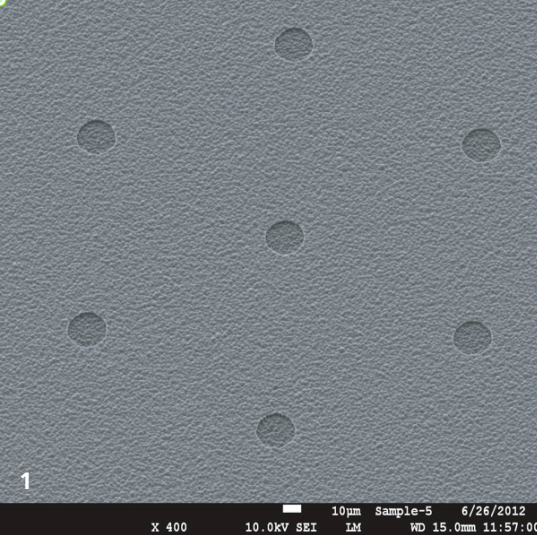
- Bioelectrochemical applications
- Dimensionally stable electrodes (DSE) in salt melts
- Electroanalytical applications
- Optically transparent electrodes
- Ozone generation
- Production of strong oxidizers
- Water analysis
- Water disinfection
- Water and waste water treatment

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OUR OFFER

CCD offers the development of customer specified boron-doped diamond products. For BDD electrodes diamond is deposited onto various substrate materials and geometries. Our in-house fabrication capabilities allow material development and prototype production of complex BDD products such as framed and freestanding BDD foils.

Microelectrodes, microelectrode arrays and optically transparent electrodes are fabricated for advanced electrochemical analytics.

BDD SYNTHESIS

Boron-doped diamond films are grown by microwave plasma assisted chemical vapor deposition. Due to the large diversity of potential applications, BDD is synthesized on many substrates including silicon, quartz, pyrex and metals such as niobium, molybdenum, titanium and tungsten.

The difference in thermal expansion between substrate material and diamond film at typical process temperatures of 450°C - 700°C requires carefully designed BDD growth conditions to prevent material failures induced by intrinsic residual stress. Depending on the application, BDD film thicknesses range from 100 nm to hundreds of micrometers.

BDD FABRICATION

Fraunhofer's in-house post diamond synthesis fabrication capabilities include:

- Cleanroom based microfabrication
- Metallization
- Wet chemical etching
- RIE plasma dry etching
- Polishing
- Laser cutting

Silicon wafers are the preferred material for fabricating specialized BDD devices since they are easily adaptable to standard microfabrication processes. Microfabrication allows customer specific designs to be fabricated. BDD foils and windows in various shapes and sizes, microelectrode arrays, macro electrodes and optically transparent electrodes are routinely fabricated according to customer specifications.

BDD ANALYSIS

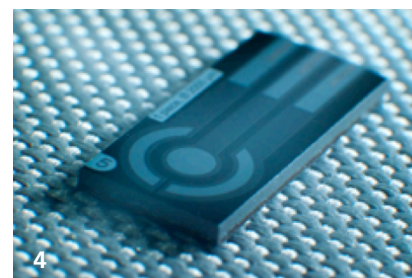
- Electrochemical analysis
- Raman
- SEM
- Conductivity
- Surface roughness
- Film thickness

Front Page:

1. Fabricated BDD electrodes on silicon
2. Microelectrode array (MEA) chips
3. Glass cell for electrode analysis
4. Potential window comparison

BDD PRODUCTS

- Nano crystalline (NCD), micro crystalline (MCD) and single crystalline (SCD) boron doped diamond materials
- BDD on silicon (1-8 inch in diameter or custom cut)
- BDD on quartz (optically transparent electrodes)
- BDD on metals (e.g. Nb, Mo, W and Ti)
- BDD on diamond
- BDD foils (framed and free standing)
- BDD microelectrodes
- BDD microelectrode arrays (MEA)
- BDD macro electrodes
- BDD prototype electrodes



Back Page:

1. SEM Image of hexagonal MEA
2. Cyclic voltammetry response of MEA (top) and macro electrode (bottom)
3. BDD products clockwise from top left: BDD on niobium stub, BDD foil, BDD prototype electrodes, 4" Ø BDD electrode
4. All BDD electrode chip