SAN JOSÉ STATE UNIVERSITY

SPARTUP Technology Transfer

FUNCTIONALIZED NANOSCALE DIAMONDS AND USES THEREOF

Enables the modification of nanoscale diamond surfaces by enhancing their reactivity, allowing for the formation of new chemical bonds at room temperature and without the need for expensive catalysts.

Case ID:
ID2021-013

IP Position:
Patent Pending

Development Status:
TRL 3: Concept demonstrated on lab platform - analytical models to support lab design

Opportunity
Partners sought for development and prototype testing, and licensing.

Category(s):
Material Science, Surface Chemistry, Nanotechnology, Biomedical Engineering

Keywords:
Diamond surface modification, bromination, carbocation, drug delivery, quantum communication

Date Released:
Description

Revision No:
1.0

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SJSU RESEARCH AND INNOVATION

Technology Overview

A technology that enhances the reactivity of nanoscale diamond surfaces, allowing for the formation of new chemical bonds at room temperature. Traditional methods for modifying diamond surfaces are often expensive and require high temperatures or plasma-based processes. However, our process uses common low-cost reagents and wet chemistry to activate the diamond surface. This involves introducing bromine atoms to substitute existing molecules on the diamond surface, creating a reactive diamond-bromine intermediate. In the presence of suitable nucleophiles, the bromine atoms detach from the surface, forming a highly reactive carbocation intermediate that can react with the nucleophile to create new covalent bonds.

This room temperature and solution-based approach eliminates the need for expensive catalysts and high temperatures, making it cost-effective and accessible for a wide range of applications, including biomedical engineering, quantum communication, sensing technology, and wear-resistant coatings.

Key Features & Benefits

- **Enhanced Reactivity:** Significantly increases the reactivity of nanoscale diamond surfaces, enabling the formation of new chemical bonds that were previously difficult to achieve.
- **Room Temperature and Solution-Based:** Unlike traditional methods that require high temperatures or plasma-based chemistry, this method allows for surface modification at room temperature using common low-cost reagents, making it more accessible and cost-effective.
- **Versatile Nucleophile Options:** The introduced bromine atoms create a carbocation intermediate, which can react with a variety of nucleophiles, such as amines and water, offering a broad range of potential reactions and applications.

Potential Applications

- **Biomedical Engineering:** Can be utilized in biomedical applications, such as creating new bonds for drug delivery systems, enabling precise tracking of diamond probes within cells and tissues, and facilitating targeted therapy.
- **Quantum Communication:** By modifying the surface chemistry of diamonds, they can be integrated into fiber optics for secure information transmission, expanding the capabilities of quantum communication systems.
- **Magnetic and Electric Field Sensing:** The reactivity of diamond surfaces allows for the engineering of nanodiamond-based sensors capable of detecting and measuring magnetic and electric fields with high sensitivity and accuracy.
- **Wear Resistance and Surface Coatings:** Can be applied to produce heterostructures by bonding diamonds with other materials, providing enhanced thermal conductivity and chemical hardness, making them suitable for wear-resistant coatings and adhesives.

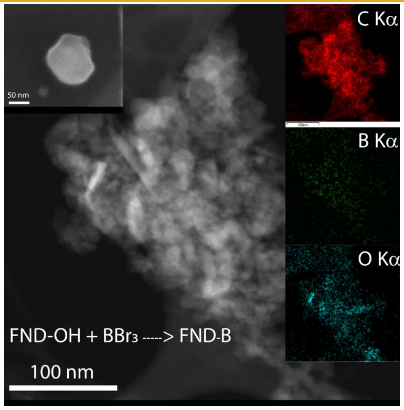

Fig 1.

High resolution TEM and EDS of ND-BBr3 deposited onto carbon TEM grids. TEM images at left shows the clustering of NDs with ultra-thin boron shells and EDS data shows the distribution of C kα, B kα and O kα.