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Purpose of Research

Conductive diamond electrodes are generally made by the CVD method, but with this method, the types of substrate materials are limited and manufacturing is expensive. In this research, we have developed an ink that contains conductive boron doped diamond powder. By coating various substrate materials with this ink, we have succeeded in simply manufacturing diamond ink electrodes in a wide range of shapes.

Summary of Research

Conductive boron doped diamond is a functional electrode material with excellent chemical stability and bioaffinity. Using this technology, by combining conductive diamond power with a polymer material, we developed a conductive diamond ink which can be used to coat various substrate materials to create electrodes. The conductive diamond ink was applied to the tip of a metallic needle, and an electrode unit was created by then wrapping the tip with an ion exchange membrane and aluminum ribbon cathode. By applying voltage to this electrode unit in water, it is possible to efficiently generate electrolytic ozone, and it has been shown that this unit can be used as a dental treatment instrument for localized disinfection.

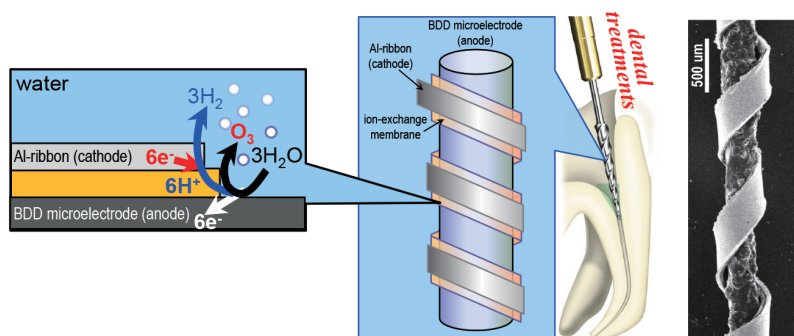


Fig. 1 Structure of the electrolysis unit and principle of electrolytic ozone generation

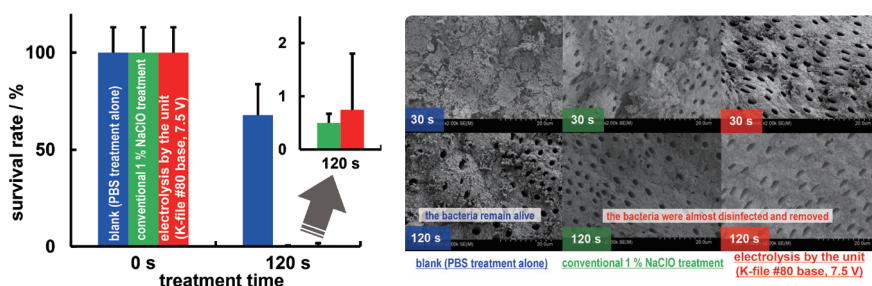


Fig. 2 Survival rate and SEM image of *P. gingivalis* in the root of a cow tooth after treatment

Comparison with Conventional or Competitive Technology

- By applying the conductive diamond ink to substrate materials with a wide range of types and shapes, it is easy to manufacture electrodes.
- Compared to other materials, it is possible to efficiently generate electrolytic ozone, thereby enabling disinfection treatments.

Expected Applications

- Dental treatment instruments (root treatments, gingivitis treatments)
- Electrochemical sensors for medical use (electrocardiogram, electromyogram, blood sugar level, measuring uric acid levels)
- Electrolytic water treatments (sterilization, produce drinking water, generate water with electrolytic function)

Challenges in Implementation

Collaboration with a company that creates prototype dental treatment instruments

What We Expect from Companies

- Create a prototype dental treatment instrument (prototyping).
- Develop new applications for the conductive diamond ink other than dental treatment instruments.

Points

- Disinfection through the localized generation of electrolytic ozone
- Uses diamond with excellent bioaffinity
- Can be used with a wide range of materials, shapes and sizes

Future Developments

- Manufacture of electrodes with an even smaller tip
- Trials using human teeth
- Study with the aim of commercialization and pharmaceutical approval
- Development of sensors and electrodes for electrolysis

- Research System: Photocatalyst Group at the Kanagawa Academy of Science and Technology, Tsurumi University School of Dental Medicine, Healthcare Oral Instruments and Materials Research Center
- Associated System: Grants-in-Aid for Scientific Research, Young Researcher (B)
- Intellectual Property: International patent application filed
- Prototype: Available
- Sample: Provision of conductive diamond power samples is subject to prior consultation