



Fabrication and Application of Diamond-Like Carbon

Materials Processing Science Research Core
Laboratory for Future Interdisciplinary Research of Science
and Technology (FIRST)

<http://www.first.iir.titech.ac.jp/english/member/core6.html>



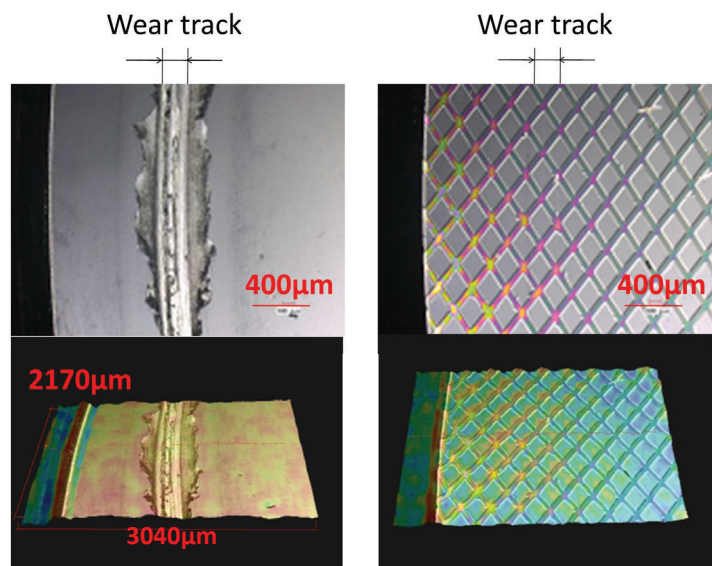
- Deposition and Systematization of Diamond-Like Carbon (DLC)
- DLC Coating Technology for Use in Harsh Environments
- Applications of DLC in Biomedical Devices
- Development of Novel Synthesis Methods for Two-Dimensional Atomic Layer Thin Films
- Fuel Cell Applications of 2D hBN Nanosheets

DLC (Diamond-Like Carbon) possesses properties similar to diamond, including high hardness, low friction coefficient, and chemical stability. Our research laboratory aim to develop surface modification techniques using functional thin films such as DLC films and 2D materials.

- ☆ To develop highly wear-resistant texture DLC films along with evaluating their mechanical and tribological properties.
- ☆ To design surfaces that protect mechanical components even under harsh conditions
- ☆ To develop high biocompatibility DLC for medical devices use
- ☆ To develop novel synthesis methods of 2D atomic layer thin films and explore its industrial application deployment the functionalities

Research on synthesize of functional thin films

- To produce BCN-based nanofilms, s.t. DLC films, graphene, hBN and so on, using such as filtered cathodic vacuum arc deposition (FCVA), arc plasma apparatus, magnetron sputtering, and nanopulsed plasma CVD equipment.
- These films are applied in mechanical and biomedical fields



Continuous structured DLC film after 3.11 m sliding under dry condition

Segmented structured DLC film after 9.05 m sliding under dry condition

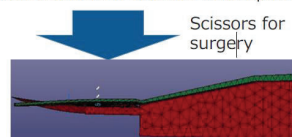
Proposal for a Segmented Structure DLC Film

- While the continuous structure film experiences complete delamination and abrasion at a sliding distance of 3.11 meters, the segmented structure shows no wear even after 9.05 meters of sliding (refer to the bottom left diagram)
- By applying segmented structure DLC, high-precision and highly durable hairdressing scissors was developed (Commercialization through a Tokyo Tech venture)

Scissors for haircutting Geek



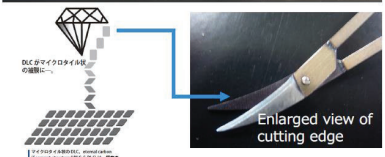
Achievements of scissors development



Scissors for surgery

Scissors for surgery (Ti-Nb/S-DLC)

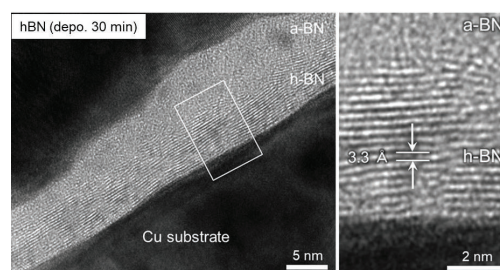
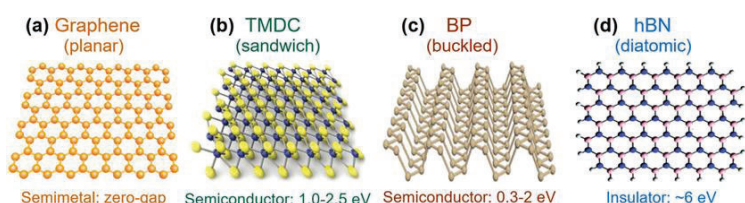
In addition to the advantage of special titanium alloy which does not break, DLC coating realizes unchanged sharpness



Enlarged view of cutting edge

Synthesis and Application of 2D materials

- Synthesis of 2D materials (Graphene, hBN) by magnetron sputtering and vacuum annealing process
- Challenging the realization of a stacking structure for 2D nano-sheets (vdWH: van der Waals Heterostructure).
- Challenging the application of hBN nano-sheets in fuel cells



✓ Amorphous BN structure was synthesized above the hBN layers

~ 20 layers of hBN

