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Plasma Application for Manipulating Surface Properties by Diamond-like Carbon Coatings and Surface Modification

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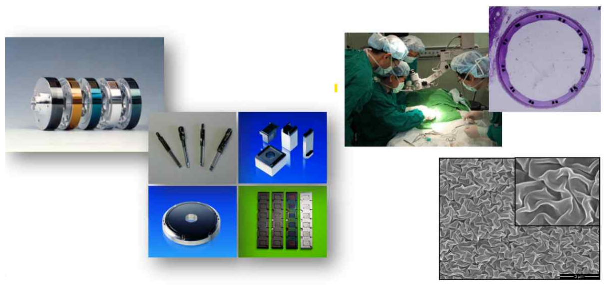
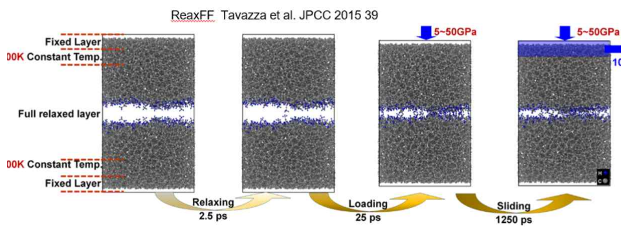
Plasma-based technologies have emerged as a versatile and efficient approach for manipulating surface properties, particularly through the application of diamond-like carbon (DLC) coatings and surface modification techniques. This presentation explores the integration of plasma processes in the deposition of DLC films and their role in enhancing surface characteristics such as hardness, wear resistance, chemical inertness, and biocompatibility. The presentation begins with an overview of plasma-assisted chemical vapor deposition (PACVD) and physical vapor deposition (PVD) methods, emphasizing their ability to achieve uniform and high-quality DLC coatings under controlled conditions. Key parameters influencing the deposition process, such as plasma power, gas composition, and substrate temperature, are analyzed to highlight their impact on the resulting film properties. Furthermore, advanced plasma treatments for surface modification, including etching, activation, and functionalization, are examined as complementary techniques to enhance the surface functionalities for various applications.

Theoretical analysis to understand the atomic scale behavior of diamond-like carbon coating and structure evolution will be also discussed. Tribological behavior of amorpous carbon surface was extensively investigated in atomic or molecular scale by the reactive molecular dynamics simulation. Simulational study of friction in hydrogenated surface of a-C revealed that hydrogenating the a-C surface only impoved the friction property drastically while not deteriorating the intrinsic properties of a-C films. The analysis of interfacial strcuture demonstrated that being different wih a-C:H cases, the competitive relationship between the stress state of H atoms and interfacial passication caused by H and C-C structural transformation accounted for the evolution of friction coefficien with surface H content. This disclosed the friction mechanism of a-C with surface hydrogenated modification and provides an approach to functionalize the carbon-based films with combinded tribological and mechanical properties for specific applications.



Various Applications of Diamond-like Carbon Films



Friction simulation by reactive molecular dynamics simulation