Mitsuda LAB.

Syntheses of carbon allotropes; diamond, amorphous carbon and graphene

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Inorganic Plasma Synthesis

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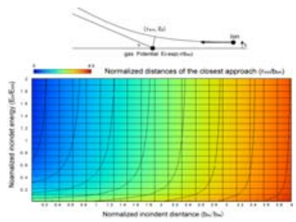
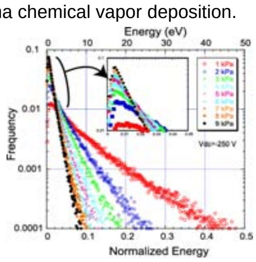
Nucleation and surface chemistry of diamond

Nucleation of diamond from the vapor phase is enhanced by applying negative bias to the substrate. To investigate the physics of this nucleation enhancement, ion energy distribution was simulated on the basis of scattering phenomena of H^+ in the plasma sheath. H^+ ion flux was measured *in situ* under the condition of microwave plasma chemical vapor deposition.

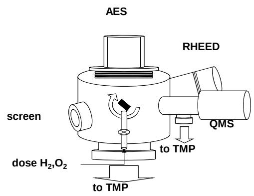
Diamond surface can be chemically terminated by hydrogen or oxygen atoms. We studied the characters of the chemical bonds, the structures and thermal stabilities of the terminations. The mechanism of diamond growth from the vapor phase will be established based on these basic chemical and physical analyses in ultra high vacuum.



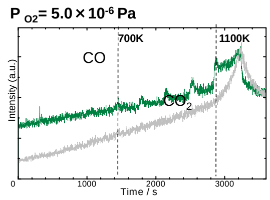
3D-scattering angles in the H^+-H collision. Motions of ions and neutlra atoms in the scattering phenomena were numerically solved in this simulation.



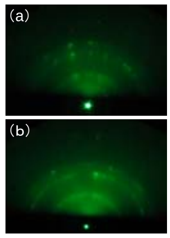
H^+ looses most energy in the sheath, i.e., plasma/substrate boundary.



Schematic diagram of the surface analysis chamber. The base pressure < 10^{-9} Pa is achieved inside the chamber. AES, RHEED, QMS and heated gas sources enable the surface modification and analyses of desorbed species



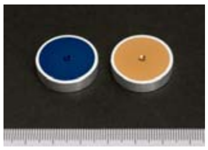
Desorption species from diamond during a thermal annealing in oxygen. Oxygen on the diamond surface is always detected as CO when it is removed from the surface. At the same time, H on the surface is removed as H_2 molecule.



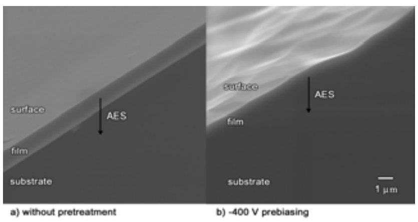
RHEED images of diamond surfaces (a) before and (b) after annealing in oxygen.

Diamond Like Carbon (DLC) thin films

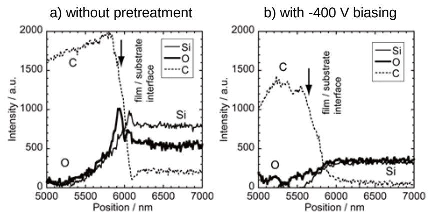
DLC is an amorphous carbon film applied for surface finishing of cutting tools and PET bottles. We are interested in the deposition of the DLC on an Al alloy, which can be used as sliding parts with light weights. It is widely know that the adhesion between the DLC and Al is weak because of the low reactivity between Al and C. In this study, the adhesion strength was improved by controlling the chemical states and structures at the interface between them.



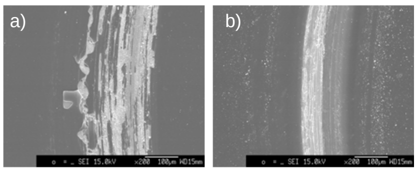
Al alloy machine components coated by the DLC films. The different colors are originated from the interference based on the film thickness, indicating the optical transparency of the DLC.



Cross sectional SEM images of DLC/Si interface. No clear interface between the substrate and the DLC film are identified in the film (b) deposited after a negative biasing to the substrate.



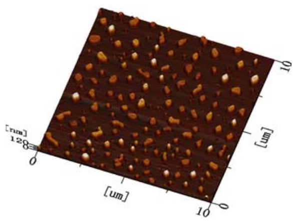
Depth profiles of the C, O, and Si measured by AES. Oxygen at the interface was removed by substrate sputtering before the deposition. The gradual change of the C concentration in the sputtered film (b) is indicative of the mixed layer of C and Si at the interface.

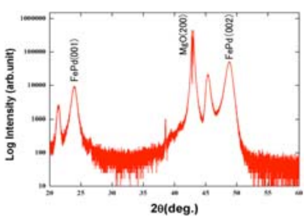


Traces of the ball on the DLC/Al alloy components after ball-on-disk wear tests. Traces of the ball on the DLC/AL components after ball-on-disk wear tests. The film delamination observed on the reference sample (a) was inhibited on the sample (b) deposited after pretreatment

Self-assembled nanostructures

Thin films with self-assembled nanostructures are formed by a bottom-up process based on the sputtering. These structures are applicable for the magnetic data storage devices.

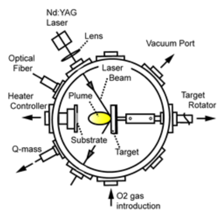




FePd nanodots with diameters of a few tens of nm were formed through the deposition of Fe seeding layer and Au agglomeration layer on a single crystalline MgO substrate. AFM image and X-ray diffraction pattern show oriented crystals and an uniform size of the FePd dots.

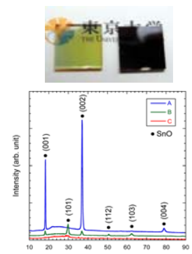
Transparent and conductive films

Transparent and conductive oxide (TCO) films are essential for flat panel displays and solar cells. We are trying to realize a novel TCO with high electrical conductivity based on SnO and SnO_2.



Pulsed-laser deposition chamber with a Nd-YAG laser. The base pressure reaches 10^{-7} Pa, reducing unwilled impurities.

New candidate elements for the impurity doping are explored by a model simulation.



Oriented crystalline of SnO films were achieved on a glass by controlling oxygen and Sn flux during the film deposition.