S7-2 Nano-crystalline carbon structures using plasma processes

プラズマを用いるナノ結晶炭素構造体研究の新展開

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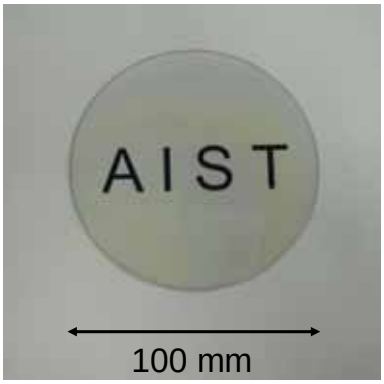
Nanostructured crystal carbon materials, such as polyhedral graphite and nanocrystalline diamond, are intriguing area for the variety of the potential applications in industry. Herein we name “Nanocrystal Engineering” for the research of the syntheses, characterization and applications of nanocrystalline materials. In this study nanocrystalline polyhedral graphite(G-Ball) synthesis by laser vaporization method and the large area nanocrystalline diamond coatings on glass using microwave plasma chemical vapor deposition (MWCVD) method are reported.

MWCVD equipped with eight linear antennas was developed. Microwave power of 24 kW at 2.45 GHz was applied to produce diamond. A high quality and smooth nanocrystalline diamond films of 5-20 nm in grain size were obtained on glass substrates at the low temperature less than 430 degC. The transparent nanocrystalline diamond film deposition over an area of 30 cm x 30 cm was attained.

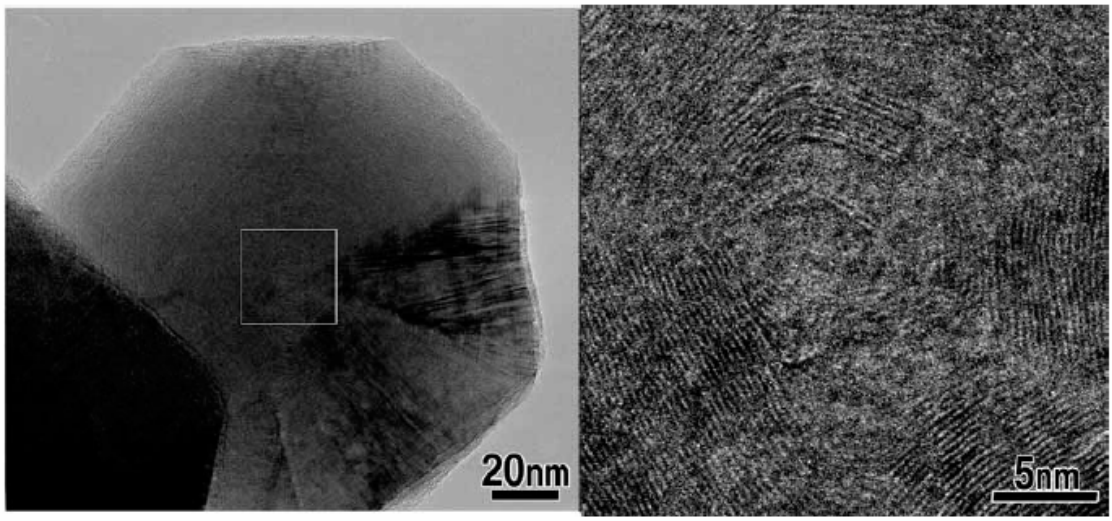
The synthesis of G-Ball is based on the condensation of carbon vapor in a

Picture of the eight-linear anntena type micro-wave plasma CVD equipment.



Picture of the transparent nanocrystalline diamond film on glass substrate.

high-pressure Ar-gas atmosphere (8 atm) using high power CO2 or YAG laser. The average diameter of G-Balls is 300 nm. X-ray powder diffraction measurements of G-Balls have been carried out up to 43GPa at room temperature with a diamond-anvil cell (DAC). From the measurement of the changes of the unit-cell volume we determined the bulk modulus of G-ball B0=38.8 GPa. Thus G-balls have a high elasticity. And G-Balls show the absence of a phase transition below 43 GPa. As the structure of G-Balls is closed frame-work, there would be only few dangling bonds. Therefore it is supposed that G-balls possess ball-bearing function which is effective to protect the sliding surface from the chemical reactions caused by friction.



High resolution TEM images of novel graphitic polyhedron (G-Ball).