Hexagonal boron nitride as a promising atomic layer material

Keywords: h-BN, wide band gap material, atomic layer

Kenji Watanabe
Electric and Electronic Materials Field / Electroceramics Group
WATANABE.Kenji.AML@nims.go.jp | http://www.nims.go.jp/eng/research/group/electroceramics/index.html

Background

- The crystal structure of h-BN composed of boron and nitrogen atoms in sp^2 bonding, has no dangling bond in the out of plane direction. Combining this atomically flat layers and its insulating properties, h-BN is suitable for "*supporting*" the research of the atomic layer physics.

Aim

- The growth to obtain high-quality crystals are limited to the crystal size of a few mm at present technology. Thus, new approaches such as a CVD method are required for the future atomic layer applications.

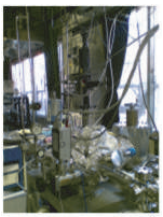
Advanced Research Topics

- Technical Issues

✓ High-quality bulk crystal growth for hexagonal boron nitride—Temperature gradient method under high pressure and high temperature condition

✓ Growth for large size growth—Technically difficult

✓ Stacking faults; probably unavoidable



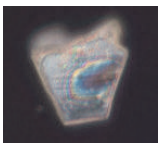
Thermal CVD Growth

- To control the crystallinity with large growth area

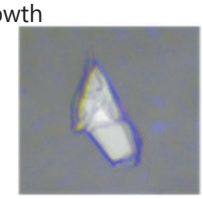
✓ Chemical vapor deposition (CVD) method

✓ Suitable growth conditions, e.g., High temperature growth

✓ Appropriate selection of substrates



Low Temperature growth



High Temperature growth

Publications

•K. Watanabe, and T. Taniguchi: INTERNATIONAL JOURNAL OF APPLIED CERAMIC TECHNOLOGY 8(2011)977–989.
•C.R. Dean, et. al. : Nat. Nanotech. 5(2010)722.

Summary

- h-BN is an appealing substrate for graphene, because of atomically smooth surface.
- Layer growth method such a CVD method is required for the future application for graphene

Research outcome

- Synthetic insulating material for atomic layer device such as graphene
- New luminous materials in FUV region
- Nonlinear optical material