課題番号　:F-14-TT-0012
利用形態　:機器利用
利用課題名(日本語)　:グラフェンの走査トンネル顕微鏡観察が微傾斜 SiC の表面上に成長させた
Program Title (English)　:Scanning Tunneling Microscopy observation of graphene grown on vicinal SiC surfaces
利用者名(日本語)　:ビシコフスキー　アントン
Username (English)　:Visikovskiy Anton
所属名(日本語)　:九州大学　工学府 エネルギー量子工学専攻
Affiliation (English)　:Department of Applied Quantum Physics and Nuclear Engineering, Graduate School of Engineering, Kyushu University

1. 概要(Summary)

Epitaxial graphene growth on SiC surfaces is of great technological importance for device applications. The first graphitic layer on SiC(0001) surface, however, takes form of buffer layer with complex 6√3 periodicity and loses graphene characteristic properties due to strong substrate influence. The main goal of our work was to study graphene growth on vicinal SiC(0001) surfaces and modification of its properties by nanostructuring and interface modifications. In particular, this year we were concentrating mainly on Si interface formation between SiC and graphene which results in buffer layer decoupling from the substrate and restoration of graphene characteristic properties.

2. 実験(Experimental)

To study the processes occurring on the surface and changes of the interfacial structures with Si we used commercial variable temperature (VT) scanning tunneling microscope (STM) machine by Omicron NanoTechnology GmbH installed in laboratory of Prof. M. Yoshimura. The SiC(0001) were introduced in the vacuum chamber and cleaned by resistive heating in a Si flux. Graphene buffer layer was produces by thermal decomposition of SiC(0001) surface. Additional Si was deposited on heated surface and structure changes were monitored by means of low-energy electron diffraction. Then, STM images have been taken in constant current mode using chemically etched tungsten tips.

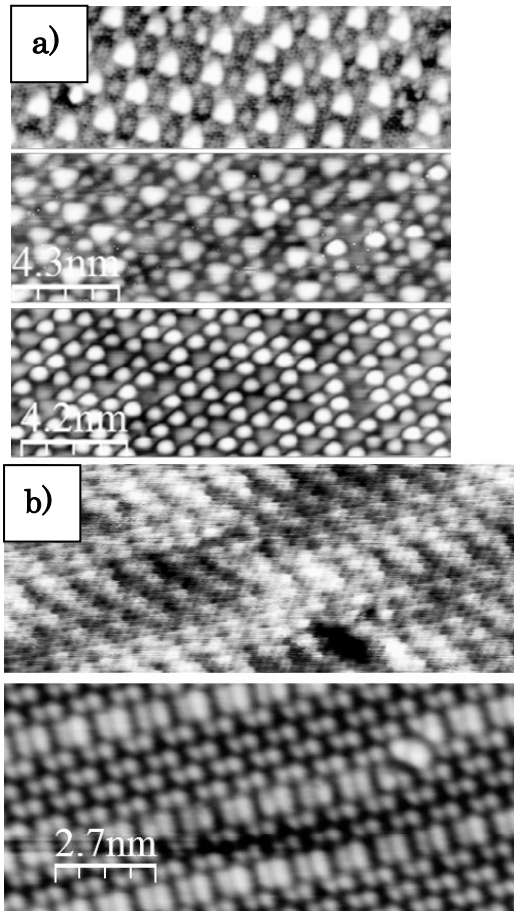

Fig. 1. (a) STM image of (3x3) interface structure under graphene (top – small bias voltage, so graphene lattice is visible, middle – filled state, bottom – empty state), (b) complex ordered structure at lower Si coverage (smaller and higher bias voltage, respectively);

3. 結果と考察(Results and Discussion)

We performed Si intercalation into graphene/SiC interface and observed resultant surface by means

of STM for different amount of intercalated Si. Surprisingly, we could observed the range of structures which STM appearance was strongly resembled to those structures formed by Si deposition on clean SiC(0001) surface. The graphene overlayer on top of these Si interface structures has been observed by low bias imaging. These results show that Si easily intercalates into (buffer layer)/SiC interface and decouples graphitic layer. Because several interface structures have been observed, graphene layer properties may vary owing to the different periodicity and properties of interface structures, which is promising way to grow graphene with desired properties modifications.

4. その他・特記事項（Others）

None

5. 論文・学会発表（Publication/Presentation）

1. 日本物理学会 2014 年秋季大会 中部大学 （９月７日～１０日): A. Visikovskiy, S. Kimoto, T. Kajiwara, S. Tanaka, M. Yoshimura “Reconstructions of Si intercalated graphene/SiC interface: atomic and electronic structure”

2. 1st Asia-Pacific Symposium on Solid Surfaces, Vladivostok, Russia (2014.9.28-10.2) A. Visikovskiy, S. Kimoto, T. Kajiwara, M. Yoshimura, S. Tanaka “Si intercalation in graphene/SiC interface”

６． 関連特許 （Patent）

None