Growth Mechanism of Graphene on Au was Revealed

Graphene, a two-dimensional honeycomb lattice composed of sp² C atoms [1], shows fascinating mechanical, thermal, and electronic properties and is promising for many applications including high-temperature coating materials. Since graphene applications require mass-production of graphene, chemical vapor deposition (CVD) has been studied among other growth methods for graphene. In CVD growth of graphene, small C molecules (growth precursor of graphene) gather on a substrate to form graphene lattice, resulting in the large-area monolayer graphene. Particularly, CVD growth of graphene on Cu from CH₄ and H₂ has been the most popular system [2]. Recently, the growth of graphene on Au substrates has attracted attention of researchers since graphene on Au was known to be applicable for electrodes of electrochemistry as well [3]. Nevertheless, the studies focused on graphene on Au have been made, but the basic growth mechanism has been still unknown so far. In addition, although there is an advantage that graphene can be grown on Au without supplying explosive H₂, the supply of H₂ affects the growth of graphene and Au, which is useful for controlling the growth of graphene to realize the high-quality graphene on Au substrates.

Fig.1 Asymmetrically optimized structure of single-layer FeSe on an oxide substrate, which was determined in this study. Se layer on the top of Fe layer becomes taller as compared to Se layer on the bottom.

References

Macroscopic properties of matter based on its local states could be understood by investigating a nanoscale region of the sample. An experimental technique that can be used to selectively investigate a surface, bulk, impurity/defect, or ultrathin film can extend the field of materials research. Existing technical developments enable us to efficiently produce high-intensity beams, especially beams of synchrotron light, electrons, neutrons, muons, and positrons, which are useful for studying various atomic structures and dynamics of functional materials. In addition, experimental techniques that correspond to each local state such as surface, interface, and impurity have been developed and they can be used to obtain new scientific insights. Our research objectives are to develop these new advanced measurement technologies and study the nanoscale structures of functional devices and materials to clarify the essential properties of matter.

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Asymmetric Structure of Single-Layer Superconductor revealed by Positron Diffraction

We have investigated the atomic configuration of single-layer superconductor of iron selenide (FeSe) using positron diffraction technique [5]. FeSe material is a typical example of Fe-based superconductors, which shows the superconducting transition temperature (Tc) of 8 K. Recently, single-layer FeSe has been successfully fabricated on an oxide substrate, and showed the highest Tc (> 50 K) among the Fe-based superconductors. Although various mechanisms have been proposed to elucidate the origin of the highest Tc, the atomic configuration remains unresolved. In this study, we performed the structure analysis of single-layer FeSe by positron diffraction, which is a surface sensitive technique owing to the positive charge of the positron. As a result, we found that the height of the top-Se layer from the Fe layer is larger than that of the bottom-Se layer, leading to the asymmetric layer structure (Fig. 1). The averaged height is almost the same as the optimum height, where the bulk-FeSe exhibits the highest Tc under pressure. Consequently, the structure of single-layer FeSe is asymmetrically optimized for the highest Tc.

References