Since electrons in graphene-based quantum dots (QDs) are promising for quantum information processing (*i.e.*, quantum bit), graphene nanodevices have therefore been studied to realize single electron/hole transport property. However, the clear characteristic of single QD (SQD) has not been established yet in graphene devices because of the formation of unintentional multiple dots in graphene caused by uncontrollable potential inhomogeneity and edge irregularity. In particular, single carrier transport at the intrinsic Dirac point (at zero gate voltage) has not been observed so far. This study aims to fabricate and measure the graphene SQD based on the following two approaches: (1) optimizing the design of the device structure, and (2) reducing the influence of charged impurity (*e.g.*, carrier localization, namely the local doping effect).

As a result of (1), it is revealed that the devices with the geometrically-defined quantum dot shows multiple dots characteristics rather than that of the single dot. This indicates that unintentional dots are formed in the graphene channel comprising constrictions and a dot structure. Moreover, simple nanoribbon devices with a longer length ($\geq$100nm) and a narrower width also exhibited the multiple dots behavior. Even though the ultra-narrow nanoribbon (width $\sim$5 nm) fabricated by the novel patterning process using hydrogen silsesquioxane, the SQD behavior was not observed in the nanoribbon with a longer length. From these results, it is understood that the formation of unintentional dots can not be avoided even in a narrow constriction if it has a longer length. In order to overcome this issue, the constriction with a short length and a narrow width can be considered as a more suitable structure to form the SQD in graphene.

For (2), firstly, the distribution of doping concentration in graphene is spatially resolved by using tip-enhanced Raman spectroscopy. It is clarified that the hole doping concentration is modulated by the order of magnitude of 10^{13} cm^{-2} within a distance of 1 μm by the variation in the device fabrication process. Secondary, the mechanism of irreversible change in carrier transport property of graphene devices by the post annealing process is elucidated by the systematic experiments and the first principle calculations. As a result, it is found that the shift of the charge neutrality point (*i.e.*, averaged doping effects in overall graphene) can be controlled by annealing in the vacuum or hydrogen gas environment.

Based on the above results, graphene constriction devices with a short length and a narrow width are studied to realize the SQD behavior in graphene. The regular Coulomb diamond and periodic Coulomb oscillation characteristics are observed at the temperature of 5 K in the certain gate voltage range, which indicates the transport property through the SQD. Comparing the extracted parameters from the transport measurements and from the geometric structure in the scanning electron microscope images, it can be considered that the single dot is formed in the constriction region. By shifting CNP near to zero voltage by annealing, transport through randomly formed multiple dots is not yet eliminated. Though the potential inhomogeneity presents in the SQD formed in the constriction region, the possibility of single dot formation is increased due to the overall reduction in the edge irregularities.

Keywords: Graphene nanostructure, Single carrier transport, Doping effect, Coulomb blockade, Quantum dot, Single electron transistor