catalyst layers and lead to the formation of intaglio-structured CNT array patterns. As the chemical masks of various materials can be facilely obtained through the micro-machining, this method brings a feasible route to control the nanoscale self-assembly of CNT structures. Based on this process, super-hydrophobic patterned CNT structures with a contact angle of 150° can be fabricated.

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Horizontally Aligned SWNT Growth on R-cut Crystal Quartz Substrates
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Orientation control of SWNTs is important for the fabrication of SWNT applications. Horizontally aligned SWNTs can be synthesized on specific substrates, such as sapphire and crystal quartz substrates, and ST-cut substrates are usually used in the case of quartz substrates. On ST-cut surfaces, SWNTs are grown along the direction of the x-axis, and the orientation is improved after the substrates are annealed at high temperature for an extended time. The orientation mechanism is understood by the atomic structure of the ST-cut surface. However, the ST-cut surface is complicated because it is an artificial surface. In this paper, we used R-cut ([101] face) substrates of crystal quartz for horizontal alignment of SWNTs. The [101] face is one of the stable faces that appear on natural quartz crystal, and it is closest to the structure of the ST-cut surface. Fe/Co metal nanoparticles supported on zeolite particles were used as catalyst. The zeolite particles were dispersed on the R-cut surface and SWNTs were synthesized by the catalytic CVD method. SEM and AFM observations revealed that SWNTs were grown along the direction of the x-axis on the R-cut surface without annealing treatment. On the R-cut surface, step and terrace structures appeared in AFM images. SWNTs were aligned in the terraced area, indicating that this surface structure aligned the SWNTs. We conclude that the ST-cut surface is a collective of small domains of [101] faces and the resulting alignment of SWNTs is owing to the [101] face structure.

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Study of relationship between diameter of carbon nanotubes and surface morphology of Al2O3 supporting layer
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It is widely recognized that single-walled carbon nanotubes (SWNTs) has emerged as alternative material for next-generation electronics owing to extraordinary electrical properties associated with one-dimensional nature. Since the electronic properties of SWNTs depend on their geometrical structures such as chirality and diameter, controlling SWNTs diameter is thus considered as an ultimate goal for application of SWNTs-based nanoelectronics. It is well known that the SWNTs diameter can be influenced by a catalytic nanoparticle size. Here, we systematically investigated the relationship between the SWNTs diameter and surface morphology of Al2O3 supporting layer. The SWNTs were synthesized on a nanostructured catalytic layer consisting of Fe/Al2O3/Si substrate using a conventional thermal chemical vapor deposition system. The morphological and chemical features of Al2O3 layer and Fe catalytic nanoparticles were studied by atomic force microscopy, scanning electron microscopy, X-ray photoelectron spectroscopy. The characterization of SWNTs was conducted by SEM and resonant Raman spectroscopy with excitation wavelengths of 514 nm (2.41 eV) and 633 nm (1.96 eV). As a result, the RMS roughness and grain size of Al2O3 layer can be controlled by adjusting thickness of Al layer. The agglomeration induced by surface diffusion of Fe catalytic nanoparticles can be governed by the structural modification of Al2O3 layer, which gives rise to change in SWNTs diameter. In the case of 15-nm-thick Al2O3 layer, the synthesis of SWNTs with an extremely narrow diameter distribution was achieved successfully.