



配向性 SWCNT の自立膜

Radovan Kukobat, Yasunori Yoshikawa

Shinshu University Research Initiative for Supra-Materials

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1. 背景と研究目的

Alignment of carbon nanotubes (CNTs) with attached iron oxide nanoparticles in the direction of the magnetic field has been demonstrated as one possibility for enhancing the strength of CNTs.^[1] Aligned CNT should exhibit excellent mechanical strength. We prepared single wall carbon nanotubes (SWCNT) film with magnetic Fe/Al complex dispersant attached on the SWCNT surface. Partial alignment of SWCNTs was confirmed with scanning electron microscopy, and thereby the further characterization with wide angle X-ray scattering (WAXS) was needed to better understand alignment of SWCNTs.

2. 実験内容

The SWCNT ink (0.05 wt.%) was prepared by dispersing the SWCNTs with Fe/Al complex (1 wt.%) with the homogenizer tip at the power of 150 W. The SWCNT ink was drop casted on Teflon substrate and placed onto the top of two connected rectangular magnets at the magnetic field strength of 0.62 T. The drying of the SWCNT ink to form the film in magnetic field lasted for 24 h at the ambient conditions. After drying, the free-standing SWCNT film was detached from Teflon sheet and washed with 1M HNO₃ for 10 min. The free-standing SWCNT film was dried in a dryer at 80 °C. Characterization of the film areas exposed to strong and weak magnetic fields will be studied with WAXS.

3. 結果および考察

We measured WAXS of pristine SWCNTs and the SWCNTs exposed to the strong magnetic fields and weak magnetic fields (Fig.1). The pristine SWCNTs show (10) peak from aligned SWCNT bundle structure.^[2] The (10) peak was shifted to the lower angle scattering region due to an effect of alignment in the magnetic field. The interlayer distances determined from (10) peak of pristine SWCNTs, the SWCNTs exposed to the strong and weak magnetic fields were 2.3 nm, 2.8 nm, and 3.2 nm, respectively. The aligned SWCNTs existed in pristine SWCNTs due to formation of the bundle structures. After exposures to the magnetic field the aligned SWCNTs were reconstructed occupying new positions in the free-standing film state. This confirms our assumption that the magnetic field can affect the alignment of the SWCNTs for improving the tensile strength of the free-standing films.

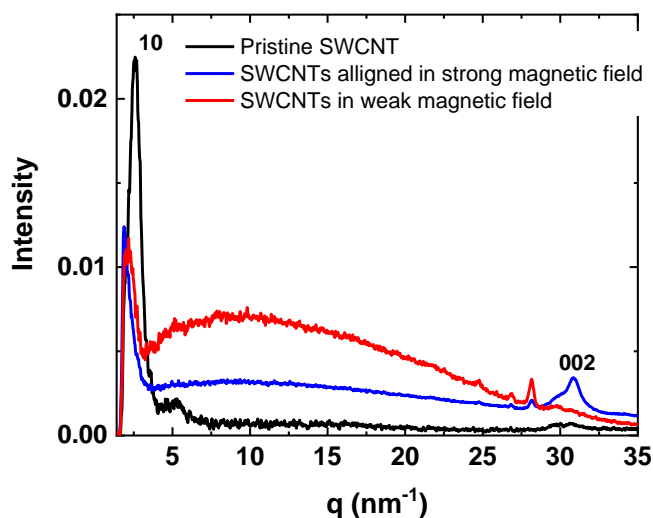


Fig. 1. WAXS of pristine and aligned SWCNTs in strong and weak magnetic fields.

4. 参考文献

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