Electrical conductivity of CNT fibres prepared from spinnable one-step CVD grown vertically aligned CNT.

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Due to their exceptional electrical, chemical, thermal and mechanical properties, CNT are particularly appealing as building block of composite fibers, in particular as conducting cables for electricity transport[1]. Several studies are reporting the preparation of fibres from CNT[2] together with the study of their electrical and mechanical properties. However, it is difficult to make a precise comparison between the different types of fibres since they are produced through various processes and with different types of CNT. Our approach consists first in elaborating CNT-based fibres from direct dry spinning of vertically aligned carbon nanotubes synthetized by a one-step aerosol-assisted CCVD process[3]. Then we measured both the intrinsic electrical properties of the individual CNTs used for fibre preparation and the electrical conductivity of the resulting fibres in order to evaluate the actual benefits of the CNT quality on the fibre performances. By considering several sections of the same nanotubes (with different length) and/or by comparing measurements at both low and high electric field, the impact of metal/CNT contact resistance was determined. The intrinsic CNT conductivity was in the 2.10^5-6.10^5 S/m range depending on the Length/Diameter ratio or the CNT crystalline structure. Electrical measurements indicate that the conductivity depends on the spinning process, especially if twisting is applied. The electrical conductivity is about $6x10^4$ S/m as compared to the maximum conductivity of the CNT used in these fibres which is around $1.5x10^6$ S/m suggesting that the preparation process of such CNT fibres can still be optimized in order to fully take benefit of the CNT intrinsic conductivity.

References

[1] Michael F. L. De Volder et al. Science, 2013, vol.339, 535.
[2] J. Steinmetz et al., Carbon, 2005 ; N. Behabtu et al., Science,2013.
[3] C. Castro et al., Carbon, 2013, 61, 585-594.

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