



HAL
open science

Growth of vertically aligned carbon nanotubes on aluminum foils

Cécile Reynaud, F. Nassoy, M. Pinault, J. Descarpentries, P-E Coulon, M. Mayne-L'Hermitte

► **To cite this version:**

Cécile Reynaud, F. Nassoy, M. Pinault, J. Descarpentries, P-E Coulon, et al.. Growth of vertically aligned carbon nanotubes on aluminum foils. 6th World congress and Expo on Nanotechnology and Material Science, Apr 2018, Valencia, Spain. cea-02339577

HAL Id: cea-02339577

<https://cea.hal.science/cea-02339577>

Submitted on 30 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Growth of vertically aligned carbon nanotubes on aluminum foils

Cecile Reynaud¹, F. Nassoy^{1,2}, M. Pinault¹, J. Descarpentries², P-E. Coulon³, M. Mayne-L'Hermite¹

¹ LEDNA, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay, France

² NawaTechnologies, Rousset, France

³ LSI, CNRS, CEA, Ecole polytechnique, Université Paris-Saclay, Palaiseau, France

Forests of vertically aligned carbon nanotubes (VACNTs) are attractive nanomaterials because of their unique structural, electrical and thermal properties. However, many applications require their growth on metallic substrates. Catalytic chemical vapor deposition (CCVD) is the best method to grow them but the catalytic particles can diffuse rapidly into the metal subsurface and thus become inactive. In this communication, I will address this issue through the recent results obtained in our laboratory. I will show how it is possible to grow VACNT on carbon fibers [1], stainless steel and aluminum surfaces by a single-step process, namely the aerosol assisted CCVD, where the catalyst and carbon precursors are injected simultaneously [2].

In the case of aluminum, due to its low melting temperature, the synthesis of VACNT requires a significant reduction in the growth temperature as compared to conventional substrates [3]. Our results show that, with our single-step process, it is possible to obtain clean, long and dense VACNTs, with a growth rate at the best state of the art level for such a low temperature. A particular attention has been paid to the study of the CNT/Al interface. The results suggest the crucial role of the interface for an efficient and reproducible VACNT growth. Finally, I will show that the aerosol-assisted CCVD process can be scaled-up [4] to enable the fabrication of innovative ultracapacitors [5] based on VACNTs grown on aluminum foils.

- [1] M. Delmas, M. Pinault, S. Patel, D. Porterat, C. Reynaud, M. Mayne-L'Hermite, Growth of long and aligned multi-walled carbon nanotubes on carbon and metal substrates., *Nanotechnology*. 23 (2012) 105604.
- [2] P. Landois, M. Pinault, S. Rouzière, D. Porterat, C. Mocuta, E. Elkaim, M. Mayne-L'Hermite, P. Launois, In situ time resolved wide angle X-Ray diffraction study of nanotube carpet growth: nature of catalyst particles and progressive nanotube alignment, *Carbon N. Y.* 7 (2015) 0–10.
- [3] C. Castro, M. Pinault, D. Porterat, C. Reynaud, M. Mayne-L'Hermite, The role of hydrogen in the aerosol-assisted chemical vapor deposition process in producing thin and densely packed vertically aligned carbon nanotubes, *Carbon N. Y.* 61 (2013) 585–594.
- [4] P. Boulanger, L. Belkadi, J. Descarpentries, D. Porterat, E. Hibert, A. Brouzes, M. Mille, S. Patel, M. Pinault, C. Reynaud, M. Mayne-L'Hermite, J.M. Decamps, Towards large scale aligned carbon nanotube composites: an industrial safe-by-design and sustainable approach, *J. Phys. Conf. Ser.* 429 (2013) 12050.
- [5] S. Lagoutte, P.-H. Aubert, M. Pinault, F.O. Tran-Van, M. Mayne-L'Hermite, C. Chevrot, Poly(3-methylthiophene)/Vertically Aligned Multi-walled Carbon Nanotubes: Electrochemical Synthesis, Characterizations and Electrochemical Storage Properties in Ionic Liquids, *Electrochim. Acta.* 130 (2014) 754–765.