

MiRNA: Delivery and imaging of miRNAs by multifunctional carbon nanotubes and circulating miRNAs as innovative therapeutic and diagnostic tools for pediatric pulmonary hypertension

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We participate to the applied research project PE-2011-02347026 (2015-2018) financed by the Italian Ministry of Health, in collaboration with the Gene Expression – Microarrays Laboratory, Bambino Gesù Children's Hospital-IRCCS in Rome and the University/British Heart Foundation Centre for Cardiovascular Science, The Queen's Medical Research Institute, University of Edinburgh, UK, devoted to “Delivery and imaging of miRNAs by multifunctional carbon nanotubes and circulating miRNAs as innovative therapeutic and diagnostic tools for paediatric pulmonary hypertension”.

Despite the advent of efficacious therapies for pediatric pulmonary hypertension (PH), prevention remains a priority. Therefore, novel therapeutic and diagnostic strategies are needed. The advent of nanotechnology offers novel possibilities for biomedical applications. Carbon nanotubes (CNTs) are promising non-toxic drug delivery vectors owing to their great ability to cross cellular membranes. The targeted delivery of miRNAs mimics/inhibitors by CNTs could contribute to limit the outcome of PH. The project assumes that the low toxicity of multifunctional CNTs together with their ability to cross easily cellular membranes can facilitate the safe and targeted delivery of specific genes and/or miRNA mimics/decoys ultimately determining a fine control of PH disease.

During 2016, physicochemical characterization of nanotubes and their derivatives were performed by SEM and TEM microscopy. To prevent the initial drawback of preparation of defects-free and metal-free CNTs, we used several commercial alternatives. Indeed, commercial CNTs are easily coated with polymers with available equipment. After first investigations with commercial CNTs coated with polymers, pristine CNTs were made in laboratory and prepared by hot filament chemical vapor deposition (CVD) method to obtain the suitable properties as particular length.

SEM and TEM microscopies were used to characterize CNTs with different length after their modification due to the coated polymer.

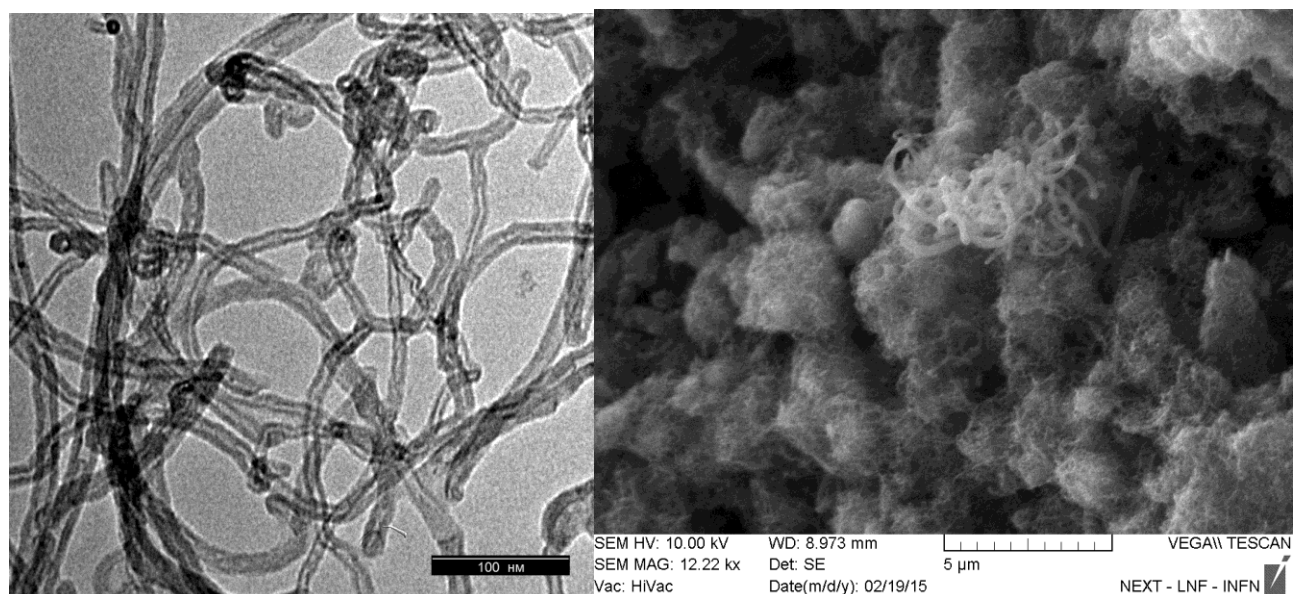


Figure 1 Multi Wall Carbon NanoTubes (MWCNT) coated with PEI. On the left TEM image (Lviv, O. Fesenko), on the right SEM image. This compound presents length 10-50 μm and diameter 8-15 nm.

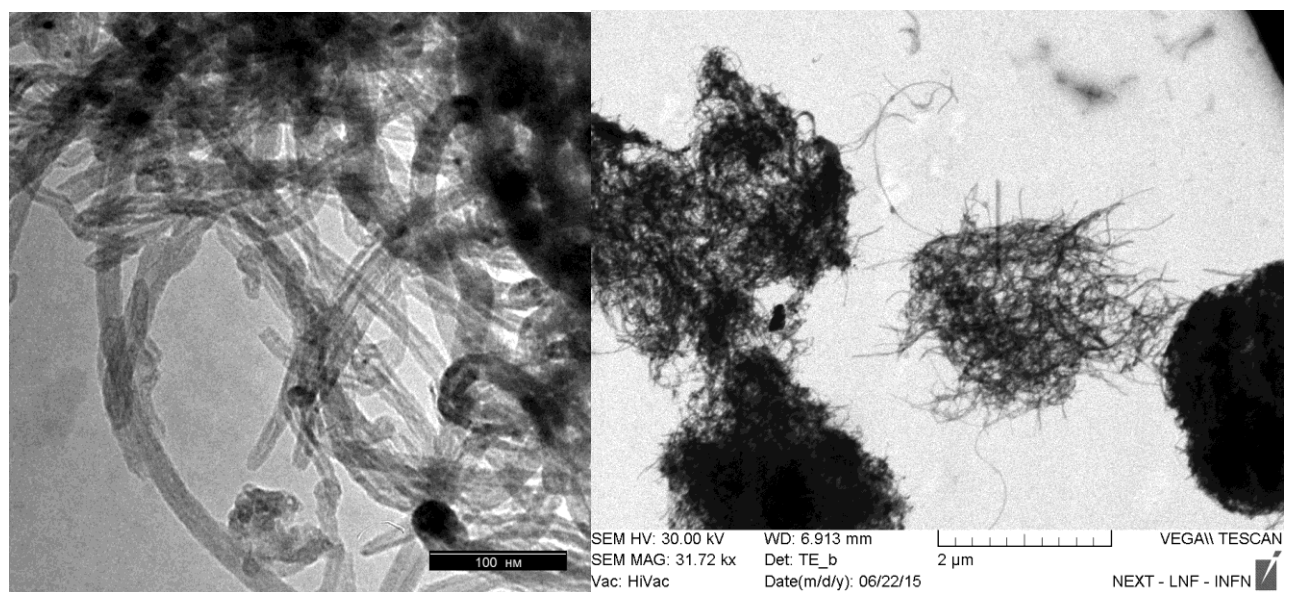


Figure 2 Short Multi Wall Carbon NanoTubes (MWCNT) coated with PEI. On the left TEM image (Lviv, O. Fesenko), on the right SEM image. This compound presents length 0,5-2 μm and diameter 8-15 nm.

Due to biological results we decide to synthesize in laboratory short MWCNT by chemical vapor deposition. First attempts show us the possibility to synthesize very short MWCNT that can be easier used for their biocompatibility.

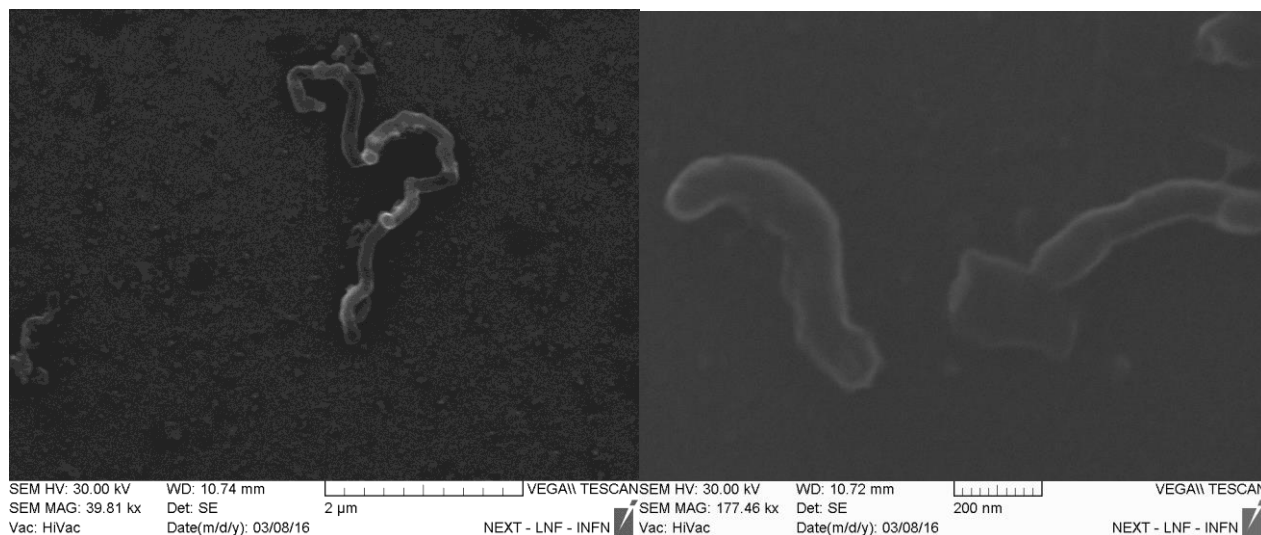


Figure 3 SEM images of short MWCNT prepared by CVD. These CNTs presents diameter 85-135 nm and lenght less than 5 μm . On the right it is shown a very short CNT with length 400nm.

List of Conference Talks by LNF Authors in the Year 2016

S. Bellucci, Conference on Nanoscience and Nanotechnology, INFN-LNF, Frascati (Italy), 26-29 September 2016.

S. Bellucci, Research Seminar, UNIVPM Ancona (Italy), 13 May 2016

Publications by LNF Authors in the Year 2016

Biological interactions of carbon-based nanomaterials: From coronation to degradation, K Bhattacharya, SP Mukherjee, A Gallud, SC Burkert, S Bistarelli, S. Bellucci, M. Bottini, A. Star, B. Fadeel, *Nanomedicine: Nanotechnology, Biology and Medicine*, Volume 12, Issue 2, February 2016, Pages 333–351

Andrea Masotti, Mark R Miller, Antonella Celluzzi, Lorraine Rose, Federico Micciulla, Patrick WF Hadoke, Stefano Bellucci, Andrea Caporali, Regulation of angiogenesis through the efficient delivery of microRNAs into endothelial cells using polyamine-coated carbon nanotubes, *Nanomedicine: Nanotechnology, Biology, and Medicine* 12 (6), 1511-1522, 31 August 2016