Sensing solution for airborne carbon nanotube exposure in workplaces

Joanna Borek-Donten
Burcu Celikkol-Zijlstra, Rudolf Bieri

Stat Peel AG, Stampfgasse 4, CH-8750 Glarus, Switzerland

Joanna.borek-donten@statpeel.com

Today's advances in man-made nanomaterials pose new and unprecedented health risks, arising especially from airborne, inhalable fiber-shaped nanomaterials, like carbon nanotubes (CNTs). *In vivo* studies indicate that inhalation of CNTs can cause adverse pulmonary effects including inflammation, granulomas and pulmonary fibrosis [1, 2]. As a result, the National Institute of Occupational Health and Safety (NIOSH) in USA recommends an exposure limit of 1µg/m^3 of CNTs as a respirable mass 8-hour time-weighted average concentration [3]. However, detecting this amount is extremely challenging with the current sensing solutions.

Here, we would like to present a wearable, cost-effective badge sensor with an air filtration system [4,5]. The sensor is capable of collecting airborne carbon nanotubes from the surrounding atmosphere on a disposable nanostructured membrane filter that simultaneously acts as a Raman substrate. The badge system is integrated with a bench-top sized optical reader for fast and automated inspection of collected samples.

Our system enables detection of sub-nanogram quantities of collected CNTs and, by utilizing the advantages of Raman spectroscopy, is a solution able to uniquely distinguish carbon nanotubes from background aerosols present in air.

References

[1] Ryman-Rasmussen JP, Cesta MF, Brody AR, Shipley-Phillips JK, Evertit JI, Tewksbury EI, Moss OR, Wong BA, Dodd DE, Andersen ME, Bonner JC, Nature Nanotech, 4 (2009) 747-751
[2] Shvedova AA, Kisin ER, Mercer R, Murray AR, Johnson VJ, Potapovich AI, Tyurina YY, Gorelik O, Arepalli S, Schwegler-Berry D, Hubbs, AF, Antonini J, Evans DE, Ku BK, Ramsey D, Maynard A, Kagan VE, Castranova V, Baron P, Am J Physiol Lung Cell Mol Physiol, 289 (2005) 696-708
[3] NIOSH CIB 65: Carbon Nanotubes and Nanofibers
[4] Patent pending
[5] Swiss Technology and Innovation Project 17623

Figures

Figure 1: Schematic of the bench-top reader and a wearable badge with integrated filtration system.