naneos particle solutions gmbh

FlowCAD

Nanoparticle Dosimeter

Mobile particle dosimeters for nanoparticles are used in rugged environment

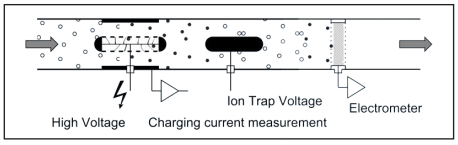
Board design for the „partector", a nanoparticle dosimeter

Engineered nanoparticles are being used in a steadily growing number of products. Due to the history of asbestos, there is concern about the health effects of nanoparticles.

Companies that manufacture or process nanoparticles must ensure that their workers are not exposed to nanoparticles. Unfortunately current measurement devices to measure aerosols and nanoparticles are mostly huge and expensive tabletop scientific instruments.

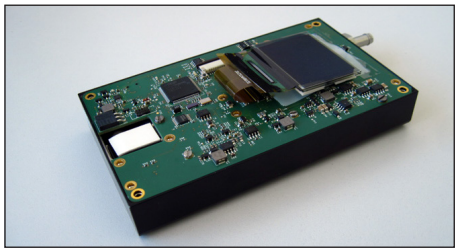
Since the spatial concentration of particles can vary a lot, portable devices are mandatory for personal exposure monitoring. Naneos has developed the world's smallest nanoparticle sensor, which can serve as a nanoparticle dosimeter, and sound an alarm when high nanoparticle levels are detected. It measures a highly health-relevant quantity, the lung-deposited surface area. The product will contribute to the safe application of the rapidly growing field of nanotechnology.

One of the simplest nanoparticle detection principles is electrical charging of the particles followed by an ultra-low current detection. First, particles that enter the device will be charged with ions coming from a corona discharge. A small electric field later catches the free ions so only charged particles enter the measurement stage.



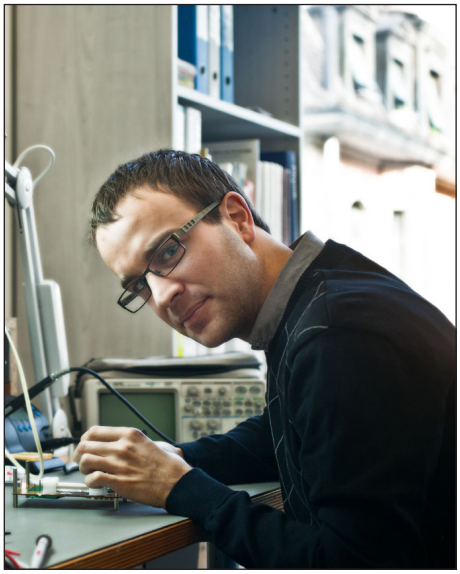
Schematic of dosimeter principle

In the measurement stage a vide tube, acting as a faraday cage, detects the charged particles. In case the charging will be pulsed one can detect an induced current when a cloud of charged particles enters or leaves the sensing faraday cage.



Integration of PCB within dosimeter

The offices of naneos are located in Technopark Windisch, Switzerland



Dominik Meier, Senior PCB Designer

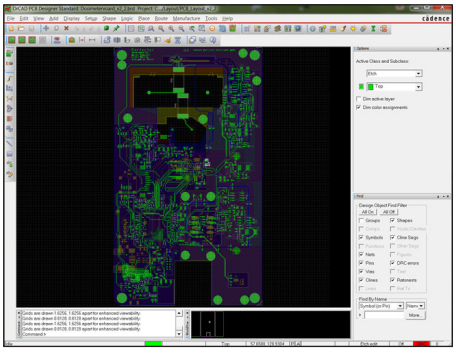
Design Challenges

One of the design rules was to have as less components as possible and the design as simple as possible. In engineering, simple also means robust and often also inexpensive. Therefore naneos tried to implement all the electronics on to one single PCB. In previous or competitive devices the different components as charger, electrometer, microprocessor and control of peripherals were realized with separately somehow complex connected PCBs. This resulted in not very portable devices which is now, thanks to the actual compact design, one of the key features of the naneos partector.

One of the key challenges was the design of a very sensitive electrometer amplifier to detect the induced charges on the faraday cage. Building very precise electrometers that can detect currents down to a few Femtoamperes is very challenging because of a variety of disruptive influences that have to be suppressed. On one hand you have to consider the electrical side with proper electrical shielding, wise layout, power integrity concept and component placement and on the other side you have to consider the mechanical influences e.g. highly insulating the measurement cell or the influence of disturbances caused by vibration and deformation on the housing. The latter is very critical in a portable device.

Additionally to these challenges it was necessary to have pulsed high-voltage of several kilovolts directly beside this sensitive measurement cell on the same PCB. This made the design even trickier not only because of the shielding. In battery powered low power devices it is very hard to deal with a pulsed power consumption of one of the components.

Common mode impedance coupling then easily happens to a variety of other functional blocks especially when you plan to implement everything on one single board. A wise selection of ground and power areas on multiple layers can help a lot when dealing with such effects.



Layout of dosimeter for nanoparticles

Tools used to design

Since the project and the company grow out of the university naneos continues to use the tools and design data formats that have been used during initial research and developments there. To not spend too much money on tools naneos works with the standard version of the Cadence OrCAD Capture and OrCAD PCB Designer.

The highly integrated design requires also the 3D-modelling of as many parts as possible. 3D-modelling of the electronics is possible in the standard version of OrCAD PCB Designer which helps a lot especially when only a few tenths of millimetres are allowed between the surrounding mechanics and electronics. The possibility to import a 3D-model of a PCB into a 3D-mCAD tool was required by naneos to design the mechancis and help to find bugs before actually producing or prototyping the mechanics. This accelerates the process of engineering a lot and also helps to keep costs low.

About naneos

Naneos is a commercial spin-off company of institute for aerosol and sensor technology of the university of applied sciences northwestern Switzerland (www.fhnw.ch/iast). Naneos has been founded at the beginning of 2012 and is now located in Technopark® Windisch, Switzerland. Naneos builds on a decade of experience in nanoparticle instrumentation development.

Naneos philosophy is to keep things simple - in engineering. Naneos strives to build instruments that are simpler to use and need less maintenance than traditional nanoparticle detectors.
www.naneos.ch

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