Diffusion based nanoparticle monitor using QCM-technology
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The use of nanoparticles has increased rapidly over the past decade. Therefore health effects of these ultra fine particles are of public concern and it has become important to monitor concentrations of nanoparticles in the air at workplaces where nanoparticles are handled.

We have developed an inexpensive method and device called nanoparticle monitor to monitor nanoparticle concentrations in the air surrounding employees. At the moment we are in a testing phase, a prototype has been constructed and the device gives a response for high nanoparticle concentrations.

The device is based on two vibrating quartz crystals (QCM) which detect particle mass deposited on them (Ho, 1984). In our current prototype, characteristic frequency of the crystals is around 5 MHz and the frequency change, caused by the deposited mass is detected with a precision of 0.1 Hz. This enables a theoretical mass sensing limit of around 2.2 ng. The crystals are placed between two polyoxymethylene-plastic blocks. The blocks are put together, with the crystals facing each other (fig1). The crystals are separated from each other with a spacer plate. The plate is hollow in the middle and the distance between the crystals can be changed by using spacers with demanded thickness. In the present study, a 0.2 mm foil was used as a spacer. The sample aerosol flows through the device and a fraction of the particles is deposited on the crystals via diffusion.

The aerosol flow rate can be varied from 0 to around 1.5 lpm. Calculations using particle diffusion equations (Hinds, 1999) predict that the greater the flow rate, the more mass will be deposited on the crystals. The 0.2 mm spacing is quite narrow and turbulence would not increase the deposition rate.

A sample aerosol was produced using a constant output atomizer (TSI) with ammonium sulfate-water-solution and was diluted with dry pressured air. The particle distribution was measured by SMPS at the beginning of the test period to get number concentration around $10^6$ #/cm³ and the mode around 50 nm.

The sample aerosol guided to the nanoparticle monitor was dried to remove moisture from the particles. A preimpactor was used to remove large particles. Particle exposure gave a clear response when the impactor’s cut 50 % diameter was as low as 355 nm.

The nanoparticle monitor will be further developed to enhance the particle deposition. In addition different methods will be tested to prevent larger particles from depositing on the crystal surfaces.

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