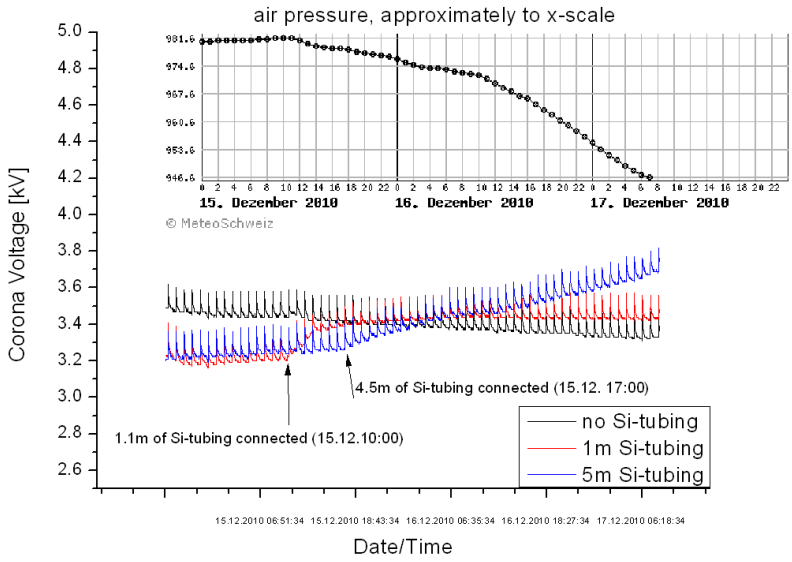
miniDiSC application note #6: Silicon oxide deposits on the corona wire

Corona tips and wires used for corona discharges usually acquire a coating which grows over time. This coating decreases the curvature radius of the wire/tip, and lowers the electric field for a given voltage; therefore, the corona voltage has to be increased to keep the particle charging level constant. The miniDiSC does this automatically. The corona voltage typically increases by about 1 Volt per hour of operation, it typically starts a bit above 3kV for a clean wire, and the maximal voltage that the miniDiSC can produce is a bit above 5kV - you should therefore get about 2000 hours of operation before having to clean the corona wire [1]. The coating on corona wires/tips is composed of silicon oxide [2], and in [2], volatile silicone oil used in personal care products (antiperspirants, cosmetics, hair care products) are claimed to be a source of the silicon ending up on the corona wire. Two newer publications [3,4] have independently identified conductive silicone tubing (often used in the aerosol community) as a source of siloxanes in the gas phase. Contamination increases with longer tubing, and at elevated temperatures. In a small experiment with 3 miniDiSCs, we could confirm that the use of silicone tubing (clear, nonconductive) resulted in a clear increase of the corona voltage, and in a much shorter cleaning interval (see graph below).
In conclusion, we recommend that you use no silicone tubing with the miniDiSC (and other instruments with corona chargers!), or as little as possible. If you must, we would recommend that you use old tubing, and/or that you bake it in an oven before using it.



[1] M. Fierz et al.: Design, calibration and field performance of a miniature diffusion size classifier. Aerosol Science and Technology 45:1-10 (2011), http://dx.doi.org/10.1080/02786826.2010.516283
[2] J.H.Davidson & P.J.McKinney: Chemical vapor deposition in the corona discharge of electrostatic air cleaners, Aerosol Science and Technology 29:102-110 (1998)
[3] Timko, M.T. et al.: Sampling artifacts from conductive silicone tubing, Aerosol Science and Technology 43:855-865, http://dx.doi.org/10.1080/02786820902984811
[4] Yu Y. et al: Contamination from electrically conductive silicone tubing during aerosol chemical analysis, Atmospheric environment 43:2836-2839 (2009).
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