

Title: Medical humidity sensor

Supervisor: Prof Hartmut Roskos

General description

Hypothetical scenario

In the case „Meyers against Angel Health Care, Inc.“, the Central Law Court of the country Humboldtia in the southern hemisphere recently ruled that the company is being fined and has to come up with compensation payments to relatives, following the deaths of three intensive-care patients, subjected to tracheal intubation-based respiration for an extended period of time in the company's hospitals. The deaths were considered to be a consequence of avoidable inflammations resulting from the dehydration of the patients. The too dry air of the respirators was found to be a decisive factor in promoting the inflammations. As a consequence of the lawsuit, the government has imposed the requirement that humidity in respirators be monitored and actively regulated at all times. The company now calls for bids for improved air humidity sensors (water in the vapor phase, not liquid water) to be installed in the respirators.

Students task description

Your boss in the MM-/THz-Wave company Future Success AG asks you to assess the available humidity sensor technologies and to let her know whether mm-/THz systems could be a viable alternative. She wants you to suggest, if possible, a measurement scheme with a proposition of a set-up which is able to perform in a sterile medical environment (within the tube of the respirator). The sensor element on its own has to cost no more than 50 € if mass-produced. The challenge of water-droplet formation on windows and lenses has to be considered either in the selection of the operational wavelength or in the technical solutions of the sensor module.

Recommended background

<https://www.medicalnewstoday.com/articles/how-humidity-may-affect-covid-19-outcome>

<https://pubmed.ncbi.nlm.nih.gov/16195655/> Article entitled "Measurement of Tracheal Humidity and Temperature"

<https://www.merckmanuals.com/professional/critical-care-medicine/respiratory-arrest/tracheal-intubation>

References:

Important:

D. M. Slocum et al., Atmospheric absorption of terahertz radiation and water vapor continuum effects, Journal of Quantitative Spectroscopy & Radiative Transfer, 127 (2013) 49-63 and references therein.

Perhaps useful:

https://www.idc-online.com/technical_references/pdfs/chemical_engineering/Water_and_Microwaves.pdf

<https://spectraio.ru/molecules/simlaunch>

https://utol.okstate.edu/sites/default/files/publications/pubs/226_190.pdf

