Development of a new particles deposition system on not-filtering substrates to perform corrosion studies

L. D'Angelo[1], M. Casati[1], V. Verdingovas[2], G. Rovelli[1], G. Sangiorgi[1], M.G. Perrone[1], C. Rizzi[1], E. Bolzacchini[1], R. Ambat[2], L. Ferrero[1]

[1]Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, 20126, Italy
[2]Department of Mechanical Engineering, Technical University of Denmark, Kongens Lyngby, 2800, Denmark
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Presenting author email: l.dangelo6@campus.unimib.it

It is well known that the presence of contaminants can promote atmospheric corrosion on metal once they deposit on them (Verdingovas et al., 2014). Many works (EL-Mahdy, 2005) focused their attention on the study of the effect of inorganic salts and organic acids in order to model corrosion rate in function of meteorological and air quality conditions. On the other hand, a critical aspect is the deposition method used to contaminate substrates. Most of studies carry out a long-term exposure of substrate on atmospheric conditions.

In this regards, a new particles collector (Figure 1) was designed at Department of Earth and Environmental Science of University of Milano-Bicocca and realized by Orlandi&Orlandi S.n.c.. The principle of operation of the collector is inertial sampling, similarly to a cascade impactor: four impactor stages and four particles size selector stages are alternated in order to obtain a well-defined size distribution (d_{ae}<2.5 µm, 2.5-1.0 µm, 1.0-0.5 µm, 0.5-0.25 µm) on each collecting substrates. Then, a filtering stage is placed. The size cut off is provided by calibrated slits designed for a 10 L min^{-1} airflow. An adjustable rotating mechanism (from 2.75 to 13.37 min $round^{-1}$) allows to sample with a round spot with a 2.0 cm diameter on the substrates. The collector was designed to hold a maximum specimen size of 5x5x2 cm. On the other hand, using a Teflon adapter smaller substrates, such as PCBs (Figure 2), stones or filters, can be used.

This device allows accelerating deposition rate of atmospheric particles on substrates and characterized the corrosion effects with a high time resolution. Indeed, because of the chemical variability of particle with time, characterization of a daily effect of particles on stone and metal specimens can be carried out.

In this regards, deposition on surface insulation resistance (SIRs) boards were carried out in order to observe the effects of atmospheric particles on conductance properties of the samples and their effects on the substrates. Sampling took place at University of Milano-Bicocca (Italy) site for 24 h during winter 2014. SIRs were then exposed to increasing and decreasing relative humidity conditions (30-90-30% RH, with ramping rate of 0.0417 RH s^{-1}) in a climatic chamber at Danmarks Tekniske Universitet (Copenhagen). The impedance measurements were obtained at 1 kHz with AC amplitude of 25 mV, with sampling rate of 2 s (Figure 3). The results showed a sharp decrease in impedance during humidification ramp at 56.8% RH corresponding to the deliquescence of water-soluble compounds according to Schindelholz et al. (2014). Similarly, during the de-hydration ramp, an increase in impedance indicates crystallization at 48.8% RH.

Thus, the new particles collector allows many kinds of different measurements and studies regarding atmospheric particles behaviour on surfaces.

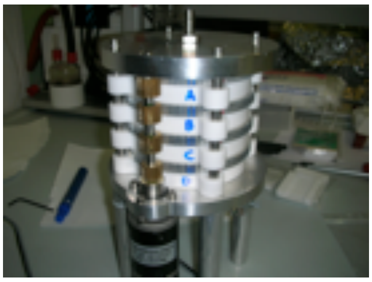

Figure 1. Rotating collector for atmospheric particles depositions.

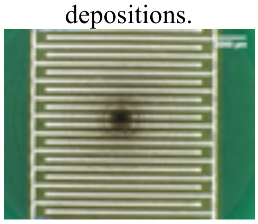

Figure 2. Deposition spot of atmospheric particles on SIR pattern.

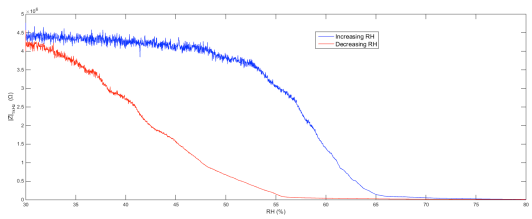

Figure 3. Impedance measurements of SIR pattern contaminated with atmospheric particles.

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