Urban grime surface film photochemistry impacting OH in urban areas

Falk Mothes, Erik H. Hoffmann and Hartmut Herrmann

Atmospheric Chemistry Department (ACD), Leibniz Institute for Tropospheric Research (TROPOS), Permoserstraße 15, 04318 Leipzig, Germany

falk.mothes@tropos.de

Multiphase processes, like the interaction of air pollutants with urban grime surface films (e.g., windows, building walls, etc.) are potentially impacting urban air quality as shown in Figure 1.

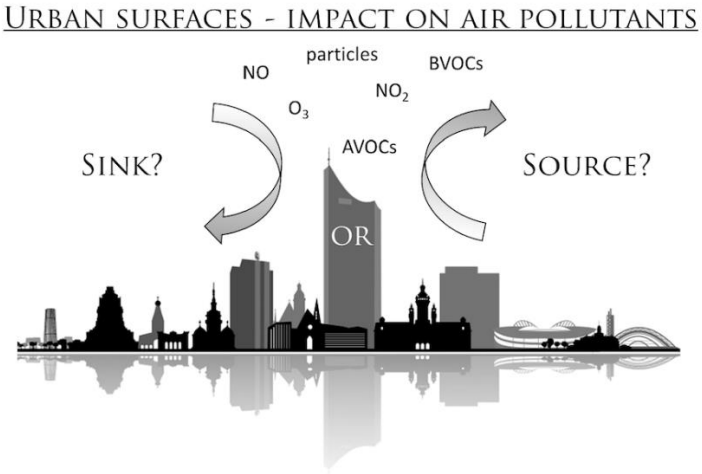

Figure 1: Scheme on the interaction of air pollutants with urban surfaces (BVOCs: biogenic volatile organic compounds; AVOCs: anthropogenic volatile organic compounds).

The present study combines real urban grime sampling on glass surfaces, collected at a European urban background site in Leipzig, Germany, with photochemical flow reactor experiments (PCFR) to characterize its photoreactive behavior and a modelling approach to assess its impact on the OH radical concentration in urban areas.

PCFR- experiments using clean compressed air, under variation of the sampling conditions (shaded vs. non-shaded surfaces) and the experimental conditions, clearly proved the formation of NO_2 and HONO with formation rates of $(2.6\pm0.6)\times10^9$ molecules cm^{-2} s^{-1} and $(8\pm1)\times10^9$ molecules cm^{-2} s^{-1} for shaded glass beads at 70% relative humidity (RH) and 21 W m^{-2} (range 300-400 nm) light intensity (LI). Additionally, a photochemically induced formation of small organics, like acetaldehyde, acetone, propanal, acetic acid and butanal has been observed during these experiments.

Furthermore, the interaction of urban grime with NO, NO_2, ozone as well as with isoprene and toluene, as representatives of biogenic and anthropogenic emitted volatile organic compounds has been studied, depending on the experimental conditions, to derive uptake coefficients and investigate further product formation.

The results are also applied to a Leipzig urban background scenario box model using the detailed CAPRAM multiphase chemistry framework to quantitatively describe the impact of observed product formation on the urban OH-radical concentration.