Urban grime photochemistry as a source for air pollutants and its potential impact on air quality

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To improve the knowledge about urban atmosphere and its pollutants within, it is necessary to understand the most relevant chemical processes and pathways of air pollutants, like nitrogen oxides (NO_x), ozone (O_3) and several volatile organic compounds (VOCs), either biogenic or anthropogenic emitted. Multiphase processes due to the interaction of such air pollutants with urban surfaces (e.g., windows, building walls, rooftops, sidewalks, roads, etc.) are potentially impacting urban air quality. The formation of surface films, often called “urban grime”, containing inorganic and organic components is a known process and can be seen as a sink of air pollutants. However, the impact of irradiation of urban grime surface films is still under investigation.

The present study combines real urban grime sampling on glass surfaces, collected in the urban background of Leipzig (with about 600k inhabitants), Germany, with small scale photoreactor experiments to characterize the photoreactive behavior of urban grime. Experiments using clean compressed air are performed under variation of the sampling conditions (e.g., shaded vs. non-shaded surfaces) and the experimental conditions, like relative humidity and light intensity. The experimental approach is extended by the analysis of the urban grime chemical composition using Curie-point pyrolysis gas chromatography-mass spectrometry for the organic and ion chromatography for the inorganic content before and after these photoreactivity experiments. The results demonstrate that irradiating urban grime surface films can result in the formation of air pollutants, for example NO_2 and HONO depending on the sampling and experimental conditions. Highest formation rates with $(2.8\pm0.3) \times 10^9$ molec cm^{-2} s^{-1} for NO_2 and $(5.7\pm0.3) \times 10^9$ molec cm^{-2} s^{-1} for HONO are observed for shaded samples and relative humidities ≥ 50%. Furthermore, application of a proton transfer reaction mass spectrometer shows also the formation of small organic compounds with m/z < 100 during the photoreactor experiments.

The poster will give a comprehensive overview about urban grime surface films acting as an additional source of air pollutants with its potential impact on air quality and associated health effects, especially in urban megacities.