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Spontaneous formation of radicals and oxidants at the air-water interface

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Aerosols are ubiquitous in troposphere. Due to their impact on human health, air quality and climate, the understanding of their physico-chemical properties is essential. There are many evidences that inside water droplets, hydrogen peroxide can be spontaneously formed. One possible explanation of this phenomenon is the presence of a strong electric field at the air-water interface. This electric field permits the dissociation of hydroxide anion into hydroxyl radical and an electron. Different mechanistic pathways can be proposed starting from this dissociation to explain the formation of hydrogen peroxide inside water droplets. Our study is focusing on this spontaneous formation and his impact in the oxidation of atmospheric aerosols.

Laboratory experiments have been done with differents instruments to measure the production of H_2O_2 and OH radicals. A nebulizer is used to generate water droplets in a range of 0.1-10 µm, from salt containing solutions. The size distribution of the droplets is obtained by an optical particle counter to have a correlation between size distribution and production of H_2O_2. After 4 hours experiments, the liquid gathered inside the reactor is collected to measure H_2O_2 production with an H_2O_2 analyser. To investigate the role of ion in the production of H_2O_2, the same experiment has been done with different salts (NH_4Cl, NaCl, and NaBr) at different concentrations. Furthermore, the production of OH radical has been detected by in solutions with terephthalic acid (TA), an OH radical scavenger that produce a fluorescent molecule named as 2-hydroxyterephthalic acid (TAOH). The fluorescence signal of TAOH has been detected in both liquid and particle phase. In the liquid phase H_2O_2 has been also detected in TA experiments.

With this study, we have strong evidence that H_2O_2 is produced in the water droplets, and its concentration is estimated to be up to 7.10^{-2} µM, depending on the type of salt, the concentration and the size distribution of the generated particles. These results are expected to improve the physico-chemical properties of atmospheric droplets.