OXIDATION OF PYRUVIC ACID AND LACTIC ACID BY OH RADICALS IN AQUEOUS SOLUTION

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The tropospheric oxidation of volatile and semivolatile organic compounds (VOCs) can be induced by radical reactions, which can occur in the gas phase and in the liquid phase (cloud droplets, fog, rain or hygroscopic particles). These VOCs will be emitted either by anthropogenic or biogenic sources. In general, the degradation and conversion processes lead to more water-soluble organic compounds, e.g., carboxylic acids. In the literature, the photo-induced oxidation pathway of pyruvic acid is described by two concepts.[1-3] The first concept states the formation of lactic acid alkyl radicals, which react afterwards with molecular oxygen to peroxyl radicals with a rate constant of $k \approx 10^9$ M^{-1} s^{-1}.[1, 2] The other approach assumes that the peroxyl radical formation is a minor reaction pathway beside the alkyl radical addition reaction to pyruvic acid – here, a much smaller rate constant of $k = 1 \times 10^6$ M^{-1} s^{-1} for the peroxyl radical formation was obtained.[3] The difference in the rate constants of the oxygen addition is of about three orders of magnitude that clearly leads to different oxidation products and yields in aqueous solution. To clarify the difference in the rate constant of the oxygen addition and its implications for pyruvic acid aqueous oxidation mechanism. Spectroscopic and kinetic investigations of the alkyl and peroxyl radicals are performed by use of a laser photolysis - long path absorption (LP-LPA) setup.

1. Griffith, E. C.; Carpenter, B. K.; Shoemaker, R. K.; Vaida, V. P Natl Acad Sci USA 2013, 110, 11714-11719.
2. Reed Harris, A. E.; Ervens, B.; Shoemaker, R. K.; Kroll, J. A.; Rapf, R. J.; Griffith, E. C.; Monod, A.; Vaida, V. J Phys Chem A 2014, 118, 8505-8516.
3. Guzman, M. I.; Colussi, A. J.; Hoffmann, M. R. J Phys Chem A 2006, 110, 3619-3626.