OH radical driven oxidation process of Pyruvic acid and Lactic acid in aqueous solution

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The atmospheric degradation and conversion of volatile and semivolatile organic compounds (VOCs) is often initiated by radical reactions, which can occur in the gas phase and in the liquid phase (cloud droplets, fog, rain or hygroscopic particles) of the troposphere. The oxidation of these VOCs emitted either by anthropogenic or biogenic sources leads to more water soluble compounds, e.g., carboxylic acids. Two concepts exist in the literature to describe the photo-induced oxidation pathway of pyruvic acid[1-3]. The first one[1, 2] 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}. The second concept[3] assumes that this is a minor reaction pathway and the formed lactic acid alkyl radical will undergo an addition reaction to the pyruvic acid. Besides a smaller rate constant of $k = 1 \times 10^6$ M^{-1} s^{-1} for the peroxyl radical formation was used[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, spectroscopic and kinetic investigations of the alkyl and peroxy radicals have been performed by use of a laser photolysis - long path absorption (LP-LPA) setup.

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