Atmospheric chemistry of second generation biofuels

Sándor Dóbé

Address: Research Centre for Natural Sciences, H-1025 Budapest, Pusztaszeri út 59-67, Tel.:1-438-1128, Fax: 1-438-1147, E-mail: dobe@chemres.hu

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Second generation biofuels (2G) are produced from biomass (non-food crops, or inedible waste products) providing the potential to reduce lifecycle CO_2 emissions and so mitigating global warming. 2G biofuels include e.g., cellulosic ethanol, bio-dimethyl-ether and Fischer-Tropsch diesel. The use of 2G biofuels will inevitable result in their release into the atmosphere. Clearly, an assessment of the atmospheric chemistry and environmental impact of 2G biofuels is needed prior to their large scale production and use.

There has been a strong interaction ("chemistry-climate-coupling") between climate change and the chemistry of the atmosphere, most prominently through the role of tropospheric ozone which is an important reactive greenhouse gas and also a toxic air pollutant. The lecture will deal with the potential effect of 2G biofuels on future O_3 considering VOC-sensitive and NO_x-sensitive chemical regimes.

A very promising new 2G biofuel is 1-butanol ("biogasoline"). The kinetics and mechanism of its combustion and atmospheric reactions will be compared by the recent literature.

At RCNS we have been studying the kinetics and photochemistry of the 2G biofuel molecules gamma-valerolactone (GVL) and ethyl-levulinate (ELA). Both GVL and ELA can be produced from cellulosic biomass using advanced catalytic processes. We have determined temperature dependent rate coefficients for the reactions OH + GVL and OH + ELA using the direct experimental techniques of pulsed laser photolysis and fast discharge flow. Apart from our own kinetic results, no information on the combustion chemistry and atmospheric fate of GVL and ELA are available. The probable reaction mechanisms are proposed to be addressed during the discussions.