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HIRAC - A Highly Instrumented Reactor for Atmospheric Chemistry

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Environmental chambers bridge the gap between isolated studies of elementary reactions and field studies. The University of Leeds HIRAC chamber is a 2 m^3 stainless steel vessel capable of operating at a variety of temperatures and pressures, with reactions initiated by 8 rows of internal lights positioned to maximise the volume of the cell ($>$85%) receiving a uniform ($\pm$10%) light intensity. Reagents and products can be monitored via a range of analysis techniques including FTIR long path absorption, gas chromatography, and commercial $NO_x/O_3/H_2O$ vapour/CO analysers. Measurements of OH and HO_2 radicals are also possible in HIRAC using laser-induced fluorescence at low pressure (FAGE), with a detection limit of $\sim 10^6$ molecule cm^{-3}. HIRAC aims to validate mechanisms of hydrocarbon oxidation relevant for models such as the Master Chemical Mechanism (MCM), to measure the kinetics of reactions which cannot be studied by isolated techniques such as laser flash photolysis or discharge flow, and to provide a test bed for the development and calibration of field instrumentation.

In this presentation, the characterisation of HIRAC and initial results will be presented. Relative rate measurements have been used to measure the kinetics of OH radical and Cl atom reactions with a variety of VOCs, using GC and FTIR detection. The dark reaction between O_3 and *trans*-2-butene has been studied using the detection of both reagents and the product acetaldehyde (in the presence of an OH scavenger), as well as OH and HO_2 concentrations, with excellent precision. A model based on the MCM and previously published OH yields was able to calculate the temporal profiles extremely well. The ability to vary pressure, temperature and other atmospheric conditions make HIRAC an ideal test bed for field instrumentation, in particular to simulate changes in altitude and facilitate calibration of aircraft instruments.