Chemistry in Fusion Plasmas: time scales and a sensitivity analysis

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In magnetic fusion plasmas one typically encounters equilibria established mainly by the transport flows driven by steep gradients and other thermodynamic forces, i.e. “transport equilibria”. These equilibria may, however, be significantly modified by atomic, molecular and radiative processes.
In order to analyze fusion plasmas, either by plasma diagnostic methods or by numerical simulation, one has to separate the (assumed known) atomic and molecular effects from the often unknown transport effects. Collisional radiative equilibrium models are used to separate the fast atomic & molecular processes from the typically much slower transport processes, by dividing up the involved species (their charge states, excitation states) into a subset of “fast” states, which can be assumed to be in quasi steady state (QSS) and a much smaller number of “slow” species, whose distributions evolves only on a time-scale comparable to the transport scale.

After a short overview over the current fusion edge plasma modeling efforts at FZ Juelich we discuss the status of the hydrocarbon break-up-model as implemented in the HYDKIN online cross section database and analysis tool, its newly developed interface to the EIRENE Monte Carlo transport code, and recent extensions of this tool, in particular aiming at generalization of the online time-scale and sensitivity analysis, are discussed.
Major remaining open data issues with respect to hydrocarbons in fusions plasmas are also summarized.