Molecule formation at surfaces in a recombining plasma

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The role of surfaces in the formation of molecules in a plasma is notoriously difficult to unravel. In this contribution we show unambiguous experimental proof of molecules (NO, NO_2, N_2O and NH_3) formed at the walls of a plasma reactor in a recombining plasma.

A mixture of N_2 and O_2 is admixed to an argon expansion, created by a cascaded arc. The N_2 and O_2 molecules are dissociated to a large extend and the produced radicals flow towards the walls of the reactor. The density of NO_2 is monitored by a dedicated mid-infrared tuneable diode laser absorption spectroscopy setup (IRMA) and a mass spectrometer. In steady state, the NO_2 mole fraction is in the order of 1E-4. After switching off both the N_2 and O_2 flow, the NO_2 mole fraction immediately drops to a negligible value. After a few seconds, a fixed amount of O_2 is admixed to the plasma, and we observe a sudden and short increase in the NO_2 mole fraction. This indicates the formation of NO_2 by the interaction of O atoms with N atoms that are still present at the walls of the reactor.

We will discuss the efficiency of the conversion of molecules and the possible mechanisms responsible for the surface formation of NO_2, but also of NO, N_2O. Furthermore, in this contribution results of a comparable study, performed on NH_3 in a mixture of N_2 and H_2 admixed to an argon expansion, will be discussed.