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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, NO₂, N₂O and NH₃) formed at the walls of a plasma reactor in a recombining plasma.

A mixture of N₂ and O₂ is admixed to an argon expansion, created by a cascaded arc. The N₂ and O₂ molecules are dissociated to a large extent and the produced radicals flow towards the walls of the reactor. The density of NO₂ is monitored by a dedicated mid-infrared tuneable diode laser absorption spectroscopy setup (IRMA) and a mass spectrometer. In steady state, the NO₂ mole fraction is in the order of 1E-4. After switching off both the N₂ and O₂ flow, the NO₂ mole fraction immediately drops to a negligible value. After a few seconds, a fixed amount of O₂ is admixed to the plasma, and we observe a sudden and short increase in the NO₂ mole fraction. This indicates the formation of NO₂ 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 NO₂, but also of NO, N₂O. Furthermore, in this contribution results of a comparable study, performed on NH₃ in a mixture of N₂ and H₂ admixed to an argon expansion, will be discussed.