VIZSLA—Versatile Ice Zigzag Sublimation Setup for Laboratory Astrochemistry: First applications and perspectives

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This presentation aims to introduce a novel, multi-functional ultrahigh-vacuum astrophysical ice setup called VIZSLA (Versatile Ice Zigzag Sublimation Setup for Laboratory Astrochemistry). The instrument allows for the investigation of astrophysical processes both in a low-temperature (3.1 K) *para*-H_2 matrix as well as in astrophysical analog ices.[1]

In *para*-H_2 matrix, the reaction of astrochemical molecules with H atoms and H^+ ions can be investigated, which efficiently simulate the processes occurring in the interstellar medium (ISM). To investigate ices relevant to real astrophysical environments, the setup is equipped with multiple irradiation and particle sources: an electron gun to mimic the secondary electrons emerging when cosmic ray particles interact with matter, an H atom beam source, a microwave H atom lamp to generate H Lyman-α radiation, and a tunable (213–2800 nm) laser source. For the spectral analysis, an FT-IR (and a UV–visible) spectrometer and a quadrupole mass analyzer (QMA) are available.

A unique feature of the setup is that it has two cryostats, offering a completely new method to study the processed ices. Upon the temperature-programmed desorption (TPD) phase, the molecules desorbing from the substrate of the first cryogenic head can be mixed with Ar and can be recaptured on the substrate of the other cryogenic head. The distance between the substrates in this configuration is a couple of centimeters. The efficiency of the redeposition was found to be 8-20% depending on the sample and the redeposition conditions. The well-resolved spectrum of the molecules isolated in an Ar matrix provides an exceptional opportunity to identify irradiation products.

A few examples are given to show how the experiments carried out in *para*-H_2 matrix and the ones utilizing the TPD–matrix-isolation recondensation technique can help us understand better the chemical processes of astrophysical importance. It is also discussed how these experiments may complement the studies carried out with other astrophysical ice setups.

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[1] Bazsó, G.; Csonka, I. P.; Góbi, S.; Tarczay, G. VIZSLA—Versatile Ice Zigzag Sublimation Setup for Laboratory Astrochemistry. *Rev. Sci. Instrum.* **2021**, 92, 124104.