

L-Valine decomposition by H^+ , He^+ and N^+ MeV ions

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Synopsis. Organic compounds observed in the ISM and in SS bodies are of particular importance for revealing the chemistry that may have led to life's origin. The main goal was to irradiate L-Valine at low temperature (10 K) by MeV ion beams (H^+ , He^+ and N^+) and determine: its destruction cross section (σ_d) due to the radiolysis; the sputtering yield (Y_0); the compaction cross section (σ_c) during crystallization; the products (daughter species) and their formation cross sections (σ_f). During the irradiation, the sample was monitored in situ by a FTIR spectrometer (in transmission mode).

Introduction

Valine (Fig. 1) is an amino acid that has been observed in extraterrestrial environments and in the Murchison meteorite [1]. The understanding of the abundance evolution of small organic molecules under ionizing radiation is relevant for models describing the spread out of prebiotics across the solar system or the Galaxy. Effects of MeV ions impinging on prebiotic molecules have been studied by FTIR at the PUC-Rio Van de Graaff Laboratory [2].

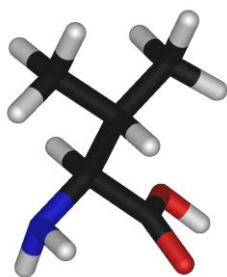


Fig. 1: Structural form of L-Valine.

Pure valine films, deposited by evaporation on KBr substrates, were irradiated by H^+ , He^+ and N^+ ion beams of 0.5, 1.0 and 1.5 MeV, up to a fluence of 10^{15} projectiles/cm². The sample damage was monitored by Mid-FTIR analysis. Typical results of the absorbance dependence on beam fluence are presented in Fig. 2. Solid lines represent two-exponential fittings; the indicated destruction cross sections (σ_d) correspondent to long fluence irradiation. It has been observed that higher is the beam energy, lower is the stopping power and lower is the σ_d value. The most abundant molecular daughter species is CO_2 , which in turn, undergoes radiolysis into $CO + O$.

Conclusions

The main effects observed are:

- Under irradiation, the valine column density decreases with cross sections in the 10^{-16} - 10^{-13} cm² range;
- Similar results were observed for all three ion beams;
- Surprisingly, the only three observed molecular daughters species are CO_2 , C_2H_6 and C_3H_8 ;

Acknowledgments:

The agencies CAPES, CNPq (INEspaço) and FAPERJ are acknowledged for partial support.

References:

- [1] P. Ehrenfreund and S. B. Charnley, *Annu. Rev. Astron. Astrophys.* 2000. 38:427.
- [2] Pilling et al, *Astrobiology* 13 (2013) 79.

Results and Discussion

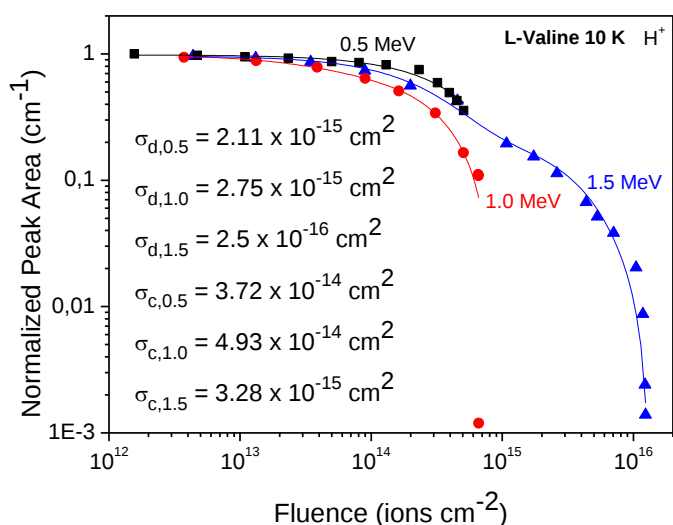


Fig. 2: Evolution of L-Valine, for 0.5 – 1.5 MeV H^+ beams.

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