DEGRADATION OF AMINO ACIDS BY MEV IONS

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Outside Earth, amino acids have been detected in the dust traces left by the Comet 81P/Wild 2 and collected by the Stardust spacecraft [1] and [2]. Similar astrophysical materials, present in comets and meteorites rich in complex molecules, could have fallen on early Earth; thereby, organic extraterrestrial molecules could have stimulated pre-biological processes and forming nucleobases and other molecular building blocks of life [3]. Knowledge on the dissociation rates of amino acids by galactic cosmic rays is relevant to the study of the radioresistance of these materials in space.

Radiolysis and sputtering of the amino acids glycine, valine and phenylalanine by 0.5 – 2 MeV H^+, He^+ and N^+ ion beams were studied. The material degradation as a function of beam fluence was monitored by infrared spectroscopy and their destruction cross sections determined. Present results show that apparent destruction cross sections (which include sputtering), σ_d^{ap}, vary proportionally with electronic stopping power, S_e, ($\sigma_d^{ap} \approx a\ S_e$), where 1/a is ≈ 120, 100 and 65 eV/nm³ for glycine, valine and phenylalanine, respectively (Fig. 1). Such values correspond to the average absorbed energy density necessary to dissociate (or eject) those molecular species and similar organic compounds from a solid sample. Assuming the relationship $\sigma_d^{ap} \approx a\ S_e$, half-lives are predicted to be ~10 million years in the interstellar medium.

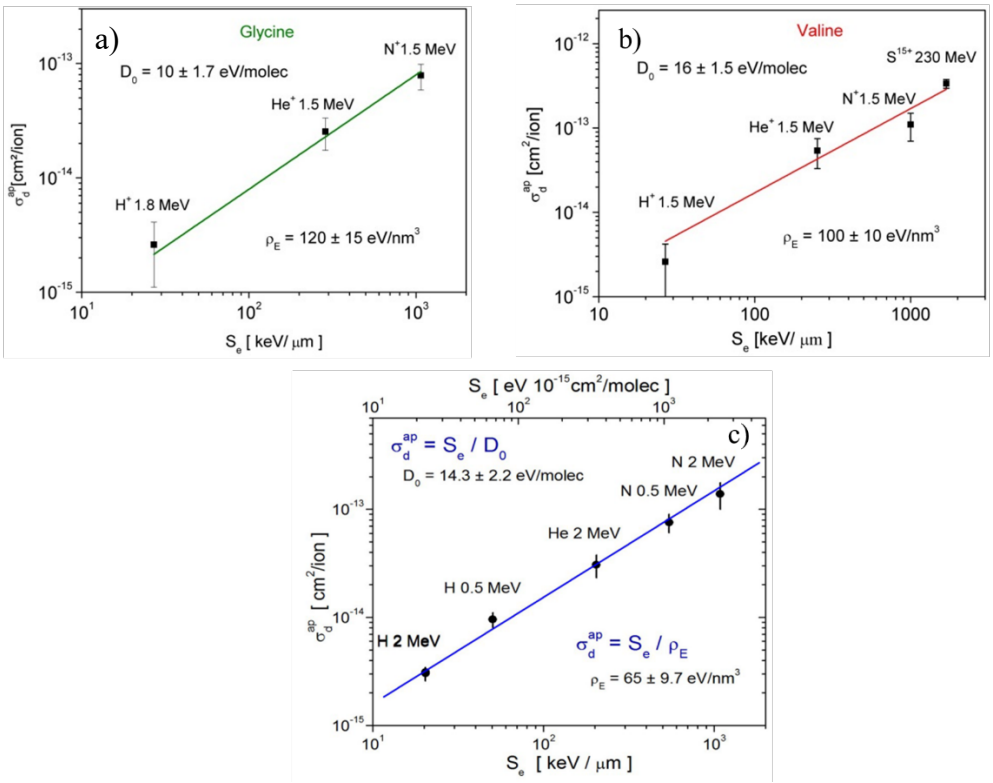

FIG. 1. Apparent destruction cross section dependence on electronic stopping power for (a) glycine, (b) valine and (c) phenylalanine. The straight line represents the power law $y = a\ x^n$, where $n = 1$. For each amino acid, the respective energy density ρ_E and dose D_0 values are extracted directly from the linear fittings with equation $\sigma_d^{ap} = S_e/\rho_E$.

REFERENCES

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