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Ion-molecule reactions in astrochemistry and for the study of the degradation mechanisms of space-technology materials

Polymers play a vital role in the aerospace industry, yet their vulnerability to atomic and ionic oxygen in space presents a significant challenge. Ground-based tests have confirmed that prolonged exposure in low Earth orbit (LEO) leads to degradation across various properties. Protective measures have been explored, but a comprehensive understanding of the erosion mechanisms is lacking. In this project, we introduce a novel approach to delve into the chemical erosion caused by monatomic oxygen ions (IO) at the molecular level. By deconstructing polymers into molecular moieties and subjecting them to single collision experiments, we aim to elucidate the underlying forces governing chemical attacks. Specifically, we will investigate reactions with polymers such as polystyrene and Kapton H, as well as carbon-based materials. Our experimental setup, guided-ion-beam mass spectrometry, will provide insights into reaction mechanisms and product branching ratios. This pioneering endeavor marks the first comprehensive effort to address polymer erosion in space, with potential implications for aerospace materials science.

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