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Carbon Nanotubes as the Protective Coating in Space Propulsion Systems YOKE KHIN YAP, JITENDRA MENDA, VIJAYA KAYASTHA, LAKSHMAN VANGA, JIESHENG WANG, ALEX KIECKHAFFER, DEAN MASSEY, LYON KING, Michigan Technological University, SVETLANA DIMOVSKI, YURY GOGOTSI, Drexel University — We have evaluated carbon nanotubes as the protective coatings against ion erosion in space propulsion systems. The space exploration program faces enormous challenges to achieve improvements in safety, cost, and speed of missions. Electric propulsion (EP) thrusters are recognized as far more efficient than chemical thrusters. However, an electrode sputter erosion process limits the lifetimes of these EP devices. Inspired by their impressive cohesive energy and stiffness, we have tested carbon nanotubes (CNTs) as the protective coating. We compare CNTs to CVD diamond, carbon and BN films as exposed to the exhaust beam of a Hall-effect thruster. We found that only CVD diamond films and VA-MWNTs survived erosion by 250 eV ions. Analysis by field emission scanning electron microscopy, backscattered electron imaging, and Raman spectroscopy indicate that these VA-MWNTs were bundled at their tips before the erosion. An erosion mechanism was then formulated and verified by a series of experiments with Xe propellant at an ion current density of 5 mA/cm². We found that VA-MWNTs are eroded in a nonlinear rate. Our result suggests that catalysts on the VA-MWNTs are responsible for this erosion and their removal could further enhance the resistance of VA-MWNTs against ion erosion.

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