

A Comparison of Sputtering Models for Plasma-Surface Interactions

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The interaction of electric propulsion plumes with spacecraft surfaces is studied in order to predict possible spacecraft contamination. For example, ions in the plume may cause surface sputtering and this sputtered material may be deposited on other surfaces. Based on experimental data, several models have been developed for the sputtering of surfaces by ion bombardment. These models depend on the ion species, energy, incidence angle, and surface material. In order to assess the uncertainty in sputtering predictions, this paper will present a comparison of models for sputtering of spacecraft materials due to operation of Hall-effect thrusters using xenon as a propellant. How this sputtering affects redeposition will also be examined. For many of the surface materials, comparisons with experimental data from literature will complement this study. An extensive review of experimental, theoretical and computational studies of sputtering (Boyd et al., AIAA 2001) provides a source for models and data. The sputter yield versus angle for 300eV ions hitting aluminum and silver is shown in the figure below for two models. The one labeled "R" is from Roussel et al., 1997. The other (labeled "Y") is from Yamamura et al., 1983. A 3-D plasma interaction modeling system named COLISEUM has been developed and will be used as a tool to test these models as well as others (for example, Kannenberg et al., AIAA 2001).

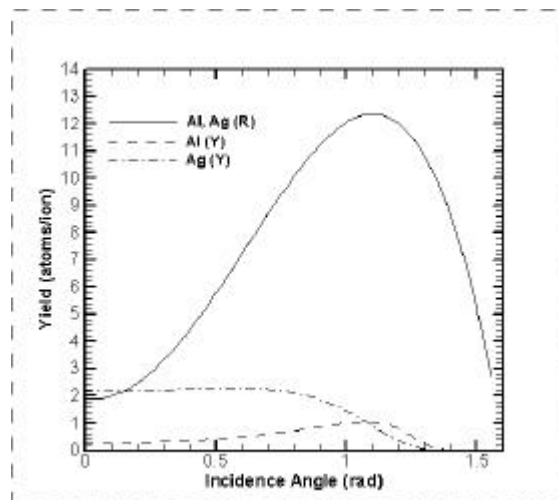


Figure: Comparison of sputter yields for Al and Ag by Xe⁺ ions at 300eV.