Atom Mobility in Ion Irradiated Solid Films

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Ion bombarded solid films show morphological modifications that cannot simply be ascribed to atom sputtering. During irradiation experiments, rather than a uniform thinning, it is common to observe the emergence of uneven distributions of material with a degree of organization depending on experimental parameters such as ion energy and film composition. A possible interpretation of this phenomenology considers ion impacts imparting a transient mobility to target atoms, which can thus reorganize and minimize surface energy with a mechanism resembling the dewetting of liquids [1]. Similarly to liquids, surface tension and disjoining pressure are still the driving forces of the process, while evaporation has a proper analogous in sputtering. However, a major difference distinguishes irradiated solid films from liquid ones: the mobility that allows material redistribution is acquired only in the region of the ion impact, and only for a short time after the collision.

Here we consider the difference between the two paths towards equilibrium by analyzing how the decrease of surface coverage of irradiated films depends on ion fluence. Experimental data are compared with the predictions based both on the thin film equation for real liquids [2], and on its adaptation that takes into consideration the locality of the process characterizing ion irradiated solid films [3].

Drawing a proper parallel between these pictures allows exploiting the physical insight offered by the thin film equation with respect to the nature of the mobility term in a context that is appropriate for ion irradiated solid films.

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[3] L. Repetto, R. Lo Savio, B. Šetina Batič, G. Firpo, E. Angeli, U. Valbusa. Nucl. Instrum. Meth. B 354 (2015) 28.