Interdiffusion in Sc/Si multilayers

Dmitriy L. Voronov [a)], Evgeniy N. Zubarev [b)], Valeriy V. Kondratenko [b)], Yuri P. Pershin [b)], Victoriya A. Sevrukova [b)], and Yegor A. Bugaev [b)]

[a)] *Lawrence Berkeley National Laboratory, 1 Cyclotron Road, MS 2R0400, Berkeley, CA 94720, USA*
[b)] *National Technical University "Kharkov Polytechnic Institute", 21 Frunze Str., Kharkov 61002, Ukraine*

e-mail: dlvoronov@lbl.gov

An understanding of interdiffusion in nano-scale multilayers is of great scientific and practical interest because the intermixing is responsible for a temporal and thermal instability of EUV and soft X-ray mirrors. In this paper we study kinetics of silicide growth in Sc/Si layered coatings. It was found that an amorphous ScSi silicide forms at the scandium-silicon interface. The growth of ScSi silicide layer obeys to a diffusion kinetics rather than a chemical reaction one. The silicide growth is limited by a diffusion of Si atoms through the silicide layer towards the silicide-scandium interface where the chemical reaction takes place. As a result of large asymmetry of interdiffusion the growth of the silicide occurs mainly at the silicide-scandium interface. The diffusion growth of the silicide deviates significantly from the classic parabolic law at the early stage of interdiffusion (Fig. 1). Such a nonlinear growth behavior can be explained with a relaxation model. The growth rate is maximal in the beginning of an annealing due to a large amount of excess free volume in the as-deposited multilayer. During the annealing a relaxation processes occurs, and diffusion slows down. Eventually the growth rate is stabilized, and a parabolic regime of the silicide growth is observed.

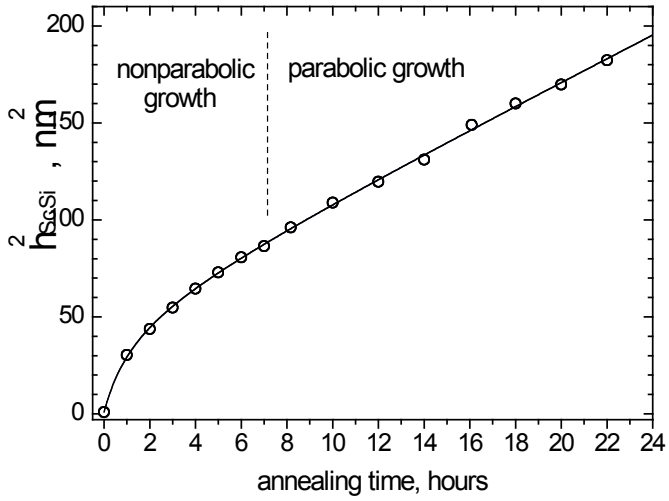

Fig. 1. Kinetics of amorphous silicide growth in Sc/Si layered coatings at 300ºC. The circles are experimental data for squared thickness (h_{ScSi}) of amorphous ScSi silicide; the curve is a fit based on a relaxation model.