Thermal evolution of Mg/SiC multilayers upon annealing

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Multilayers with high reflecting power are necessary for applications like solar imaging or photoemission microscopy using the He II line (30.4 nm). It is been proposed by Ejima *et al.* [1] to use Mg/SiC multilayers because of the low absorption coefficient of the Mg atoms after the L absorption edge at 25 nm. More recently, Takenaka *et al.* have obtained a reflectivity as high as 40% with the Mg/SiC multilayer at 30.4 nm [2]. Because of its recent development, the Mg/SiC system has been little characterized. For example, with respect to Mo or Si, Mg is highly reactive and has a relatively low melting point (649°C). These properties could lead to a difficult control of the time- and temperature-stability of the Mg/SiC multilayers, despite their high reflectivity.

The multilayers are prepared by magnetron sputtering. They consist of 30 Mg(12 nm)/SiC(5 nm) bilayers deposited on a silicon substrate. The multilayers are studied as-deposited and after annealing up to 500°C, by a non-destructive methodology [3,4] combining x-ray reflectivity (XRR) in the hard and soft x-ray ranges and x-ray emission spectroscopy (XES). XRR is used to obtain a geometric description of the stack (thickness and roughness of the various layers) and XES to know the chemical state of the Mg and Si atoms within the samples and thus to know if interfacial silicides are formed.

Up to 200°C, the multilayer reflectivity is almost constant and no interfacial compound is observed. For higher annealing temperatures we evidence two transitions. First, between 200 and 250°C a large decrease (80%) of the optical performances is observed while no significant evolution of the chemical state of the sample is detected. This is due to the large development of the roughness, probably due to the crystallization of the Mg layers. Second, between 350 and 400°C, the reflectivity is loss while the formation of the Mg_2Si compound is observed. This transition temperature corresponds to the destruction of the multilayer. Thus the Mg/SiC multilayers can be used safely at temperatures not higher than 200°C.

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[3] H. Maury et al., Thin Solid Films 514, 278 (2006)
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