Nanocomposites and nanomaterials

Si/Mg_2Si multilayers for 30.4 nm wavelength

L. E. Konotopskyi, I. A. Kopylets

National Technical University «Kharkiv Polytechnic Institute»,
27 Frunze Ave., 61002 Kharkov, Ukraine
e-mail: l.konotopscky@yandex.ua

In recent years the Sun and in particular the processes that occur in its crown are of interest of astrophysicists. X-ray spectroscopy of the coronal plasma that contains a number of strong emission lines of atoms of He ($\lambda_{He\text{-}II}$ = 30.4 nm) and Fe ($\lambda_{Fe\text{-}XV}$ = 28.4 nm) with different degrees of ionization, allows to test theoretical models of various structures of the solar corona [1]. Therefore, the solution of problem of obtaining of X-ray spectral images of solar disk and the corona in the emission of iron and helium ions that corresponds for mono temperatures of the solar atmosphere plasma are of particular interest for astrophysicists.

We proposed X-ray mirrors that are based on Si and Mg_2Si. Si/Mg_2Si X-ray mirrors can provide reflectance of about 41% at 30.4 nm at normal incidence angle. It is expected that Si/Mg_2Si X-ray mirrors will have high thermal and temporal stability, due to using of magnesium silicide as spacer layer.

A study of new periodic multilayers based on the pair of materials Si-Mg_2Si was made. X-ray diffraction methods were used for investigation of structure of Si/Mg_2Si multilayers deposited by DC magnetron sputtering on Si (001), Si (111) and on glass substrates in initial state and after annealing (50 – 750 ° C). In initial state layers of Si and Mg_2Si in Si/Mg_2Si multilayers are amorphous. Fitting of the experimental spectra of low-angle X-ray diffraction showed that interlayer roughness in Si/Mg_2Si multilayers is about 0.4 nm, which is significantly lower than that in SiC/Mg multilayers. The calculated value of reflectance for 30.4 nm and normal incidence angle for Si/Mg_2Si X-ray mirrors with a real layers structure was 38%.

Thermal annealing of Si/Mg_2Si multilayers in the temperature range of 50–750 °C lead to decreasing of period by 1.32 nm. Results of thermal annealing of Si/Mg_2Si X-ray mirrors suggest that Si/Mg_2Si multilayers are stable up to 700 °C.

For the first time thermally resistant X-ray mirrors were created for the wavelength range of 25-35 nm on basis of materials Si-Mg_2Si.

1. *Shestov S.V., Bozhenkov S.A., et al.,* Solar EUV Spectra Obtained during the SPIRIT Experiment Onboard the CORONAS-F Satellite: A Catalog of

Lines in the Range 176–207 A // Astronomy Let.-2009.-**35**, N 3.-P. 50-62.