Characterization of multilayers and their interlayers: Application to Co-based systems

Philippe Jonnard,*
Laboratoire de Chimie Physique – Matière Rayonnement, UPMC Univ Paris 06, CNRS UMR 7614, 11 rue Pierre et Marie

* Corresponding author: philippe.jonnard@upmc.fr; Tel/Fax:+33 (1) 44 27 63 03 / 62 26

Abstract
In the framework of a French-Chinese project we develop Co-based periodic multilayers. These structures are made of layers having a thickness of some nanometers and are designed as optical mirrors for the extreme UV (EUV) and soft x-ray ranges. The multilayers are prepared by magnetron sputtering then checked by x-ray reflectivity in the hard x-ray range. The stacks are thoroughly characterized in order to have a clear vision of the phenomena taking place at the interfaces. Indeed, the quality of the interfaces, where interdiffusion and roughness can occur, is responsible for a large part of the optical properties of the mirror in terms of reflectance and bandwidth. The used characterization methods are x-ray emission and nuclear magnetic resonant spectroscopies in order to determine the chemical state of the various atoms present in the structure, transmission electron microscopy on cross section of the sample to get an image of the layers and their interfaces and possibly secondary ion mass spectroscopy to obtain the elemental depth profile at the nanometric scale. Then, from the detailed description of the stack we are able to understand and fit the reflectivity measurements performed at the application wavelength in the EUV or soft x-ray range. We have already studied the Co/Mg system in which we have introduced thin Zr layers at some interfaces and demonstrated the abruptness of the interface from the chemical and magnetic point of views, the high reflectivity larger than 50% around 25 nm (50 eV) and the thermal stability up to annealing temperature 300°C. We now concentrate on the Co/Sb and Co/Mo2C systems designed to work in the soft x-ray range. We present our first reflectivity measurements obtained with synchrotron radiation in this range and discuss the change of the optical properties as a function of the annealing temperature up to 500°C.