Depth graded multilayers for hard X-ray telescopes

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We are developing depth-graded, multilayer-coated mirrors for astrophysical hard X-ray focusing telescopes. The two factors that most greatly influence telescope performance are interfacial roughness and coating thickness uniformity. We have coated and characterized depth-graded and single d-spacing multilayers on epoxy-replicated aluminum foils (ERAFs) and thermally formed DESAG glass, the two substrates that we are considering for our balloon-borne hard x-ray telescope project. The reflectivities of these mirrors were measured using specular reflectivity scans at several energies from 8 to 30 keV. From the reflectivity scans, we have determined the average interfacial roughness of the coatings and the thickness uniformity of the coatings on the curved optics. We have modelled the effects of interfacial roughness and thickness nonuniformity on the collecting area of the telescope, both on and off axis. Using the measured parameters, along with figure measurements of the substrates, we predict the performance of the final telescope and compare it against other current X-ray telescopes.