NOVEL MULTILAYER DESIGNS DEMONSTRATING NEAR LOSSLESS REFLECTIVITIES

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General Electric has designed a fundamentally new, solid phase, multilayer, photonic device for concentrating x-ray photons from a diverging source via multiple total internal reflections at the boundaries between high refractive index transmission layers and engineered lower refractive index multilayers. High flux gains are achieved by compressing the divergent polychromatic source beam into a less divergent output beam. During the compression process, the x-ray photons undergo as many as 5000 reflections, requiring losses on the order of 10^{-4} at each reflection in order to obtain substantial overall flux density gains from these devices. The conventional design wisdom to achieve such near lossless reflections has been to increase the refractive index contrast between the high and low index materials. However, this is only valid when the absorption or imaginary part of a material's refractive index can be ignored. While this can be a valid at visible light wavelengths, at x-ray wavelengths, we have found, almost counter intuitively, that the imaginary refractive index component is critical to enabling such near lossless reflectivities. In this presentation, we will present both theoretical simulations and experimental data demonstrating a novel method for selecting the materials for solid phase multilayer x-ray photonic devices that have demonstrated world record x-ray reflectivities at x-ray energies up to 250keV.