Iridium-Alumina Nanolaminates for Epsilon Near-Zero Coatings in the DUV Spectral Range

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Iridium-alumina nanolaminates have been developed by means of atomic layer deposition (ALD) towards epsilon near-zero metamaterials in the deep UV (DUV) spectral range between ca. 190-260 nm. Atomic layer deposition is a powerful technique for depositing ultra-thin metallic coatings of iridium with precise thickness control [1]. Iridium ALD coatings are closed layers at a thickness of approximately 5 nm, and have relatively smooth surfaces with a surface roughness below 1 nm as measured by atomic force microscopy. The iridium ALD process has been extensively optimized [2] to improve the adhesion of metal to fused silica substrates.

Near-zero epsilon effective permittivity values have been measured by means of ellipsometry for a nanolaminate containing 3 ultra-thin Ir layers within alumina dielectric (see Figure 1). Simultaneously, the reflectivity of the nanolaminate is reduced down to 1% at ca. 225 nm wavelength.

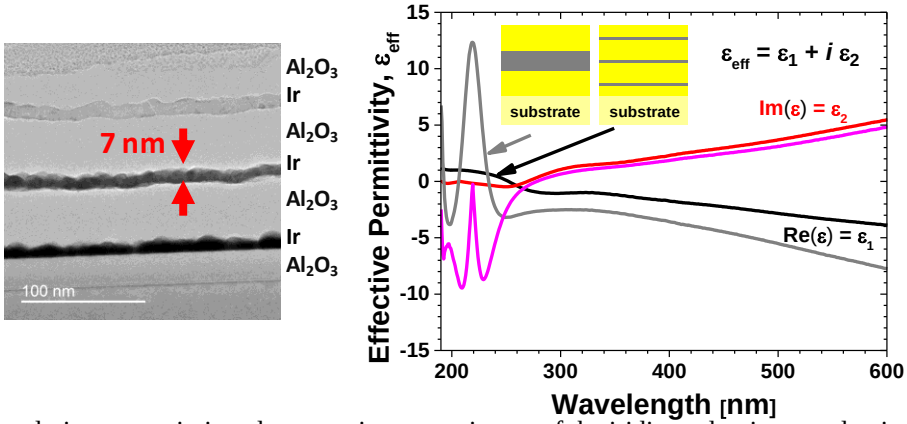

Fig. 1: High resolution transmission electron microscopy image of the iridium-alumina nanolaminate, and experimental effective permittivity of the nanolaminate (black = ε_1, red = ε_2) compared to the simple dielectric-metal-dielectric layer system (grey and pink curves).

References:

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