NANOINDENTATION AND OPTICAL PROPERTIES OF TRANSPARENT METAL OXIDE MULTILAYERS

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Key Words: optical nanometallic multilayers, sputtering, nanoindentation

Multilayers are a unique class of thin films and coatings comprised of alternating layers of different materials, with layers being anywhere from the macro to nanoscale. The interplay of these layers increases the potential for novel combinations of properties, including transparency and strength [1-3]. Optically transparent multilayers are promising materials because they offer extraordinary strength, hardness, heat resistance, and most importantly, transparency in both the UV-Vis and NIR wavelengths, which traditionally used silicate glass lacks [4]. These properties are important for applications such as sensor and telescope preservation, which require light penetration for function but a robust barrier for protection.

This study seeks to produce transparent multilayer thin films via sequential magnetron DC/RF sputtering, focusing on optimizing the mechanical and optical properties. Initial compositions, layer thicknesses, and interface arrangements in these optical multilayers are examined to tailor and optimize transmittance in the UV/Vis/NIR wavelengths. The layer thicknesses, thickness ratios, interfaces, compositions, and nanoscale microstructural features impact mechanical properties and can be altered through sputtering conditions. In order to assess the deformation mechanisms and the effect of changes in the multilayer parameters, nanoindentation was performed. Overall this study presents the synthesis of optical multilayers and how the resulting microstructures influence hardness and transparency.

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