

## **Mueller Matrix of Specular Reflection by an Aluminum Grating Surface with Oxide Nano-Film**

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The accurate nondestructive and real time determination of the critical dimensions of oxide nano-films on periodic nano-structures has potential applications in nanofabrication techniques. Mueller ellipsometry is fast, accurate, nondestructive, and can be used in air. This study used the elements of a Mueller matrix of specular reflection, which is based on a Mueller ellipsometry method, to evaluate the thickness of an oxide nano-film on an aluminum grating surface. By using the rigorous coupled-wave analysis (RCWA), we decomposed the Mueller matrix to obtain the relationship between the evaluated polarization properties of reflected light and the dimensions of oxide nano-films on aluminum grating surfaces. We also quantitatively analysed the Mueller matrix elements variation by the thicknesses of top, sidewall, and bottom oxides, considering the nonuniform naturally oxide nano-films on grating structures. The results show that the elements of Mueller matrix shift with the increasing of the uniform thickness of oxide at a fixed wavelength. Moreover, as oxide nano-films on grating structures are nonuniform, the impact of the thickness of side wall oxide on the Mueller matrix elements is more obvious than that of top and bottom oxides at the relative larger incidence wavelength range. The finding of this work may facilitate the nondestructive and real time measurement of the thickness of oxide nano-films on metal grating structures in which the metal is easily oxidized.