Developing An Error Budget For The Creation Of A Multi-Layer Thin Film

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Overview

In order to create a new display technology, the creation of an electrically tunable perfect light absorber via multi-layer thin films is being pursued. However, errors often occur during the growth of multi-layer thin films. Thus, it is necessary to determine how these errors affect the thin film’s properties.

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Method

Reflectivity (R) of the thin film was calculated using the Transfer Matrix Method via Matlab code. Each layer’s real refractive index (n), imaginary refractive index (k), thickness (d), and their respective error percentages could be independently controlled. R was calculated in 5 nm wavelength steps from 350 nm to 1000 nm, using randomly chosen values for n,k, and d within their error range. The code returned the average R as well as the standard deviation. The initial n and k values were obtained from the website RefractiveIndex.info.

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\begin{align*}
R = \left( \frac{r}{i} \right)^2 = \left( \frac{M_{2,1}}{M_{1,1}} \right)^2
\end{align*}
\]

Results

R was calculated for n,k, and d errors in several different combinations. Higher standard deviations (error bars) indicate larger effects on the Reflectivity of the thin film.

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References