

Algorithm for SCC Color Neutrality

2016 AP²D Metallic-Dielectric Subgroup

Bright¹ Sai²

¹Division of Engineering Science
University of Toronto

²Department of Electrical and Computer Engineering
University of Toronto

May 27, 2016

Outline

Algorithm for
SCC Color
Neutrality

Bright, Sai

The Problem
/ Existing
Algorithm

Blue / Green
Tinge in AIN
Coating
Existing
Algorithm

Color
Neutrality /
New
Algorithm

Quantitative
Color Neutrality
Various Methods
of Controlling for
Color Neutrality
Results

Future
Improvements

1 The Problem / Existing Algorithm

- Blue / Green Tinge in AIN Coating
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3 Future Improvements

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Blue / Green Tinge in AlN Coating

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- Current AlN single-stacked and double-stacked SCC have a blue / green tinge.
- Ideally SCC coatings should be color neutral, but previous optimization code optimizes for VLT TSER without regards for color neutrality.



Figure: Non-Color Neutral SCCs

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The Problem

Previous Algorithm

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- Algorithm has equally weighted "priority" variable for VLT TSER
 - Including another item into "priority" would decrease values of VLT TSER
- No good understanding of what color neutrality is, quantitatively

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Transmission and RGB Values

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- Color is neutral when $R=G=B$. This gives ranges of color on the neutral color scale of white to grey to black (RGB 255 to 0)
- White paper and back-lit experiments determines that transmittance results in non-neutral color.
- The transmission and reflection curves should not have narrow peaks in the visible spectrum.

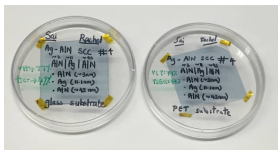


Figure: SCC 4

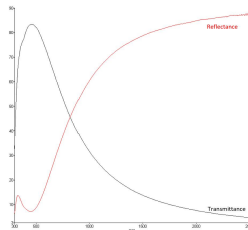


Figure: SCC 4: T Peaks in Blue

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Removing TSER Priority in Visible

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- Previously, TSER from all wavelengths set as priority along with VLT.
- But 42.6 % of AM1.5 is in the visible, maximizing TSER conflicts with maximizing VLT and results in transmission peak.
- Change: separate to maximize transmission in visible, and maximize TSER in IR.

Incorporating Both AM1.5 and Photopic for Transmission

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- Previously, optimized to weighted photopic curve assuming equal intensity of incoming light in visible.
- But AM1.5 varies in the visible, only transmitted AM1.5 should be fitted against the photopic.
- Attempted to change to transmitted AM1.5, but little difference due to near equal intensity of AM1.5 across visible.
- Future improvement: to recalculate RGB in terms of AM1.5 and check for differences

Changing Curve Fitting Method

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- Previously, computed weighted average.
- But the photopic curve is very sharp, peak = 1 at 555 nm but drops very quickly to negligible $4E-4$ at 400 nm.
- Very low priority for transmission in far wavelengths of the visible and TSER in visible was a priority: results in very sharp transmission peak in visible.
- Change: to use minimize root mean square error of transmission curve against AM1.5 to "broaden" the transmission curve in the visible for equality.

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Graphical Results

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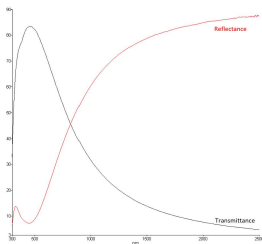


Figure: Previous Result (SCC 4)

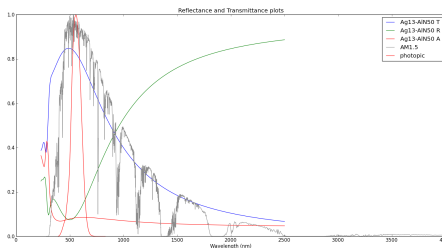


Figure: Result with New Algorithm

Statistical Results

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- SCC 4: VLT: 77, TSER: 47 (experimental)
- new SCC: VLT: 79, TSER: 40 (theoretical)
- T color: (206, 209, 211) R color: (27, 24, 24)

Potential Improvements

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- Include UV (rejection? reflection?)
- Better metrics than VLT and TSER
- Other methods to not compromise 5 TSER