

On behalf of Vision Expo, we sincerely thank you for being with us this year.

Vision Expo Has Gone Green!

We've eliminated paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended!

Your feedback is important to us as our Education Planning Committee considers content and speakers for future meetings to provide you with the best education possible.



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Financial Disclosure Statement

Andrew Bruce has received honorarium from:

- VSP Optics/UUniversity
- Mitsui Chemicals America, Inc.
- Optical Training Institute

- All relevant relationships have been mitigated
- He has NO financial interest in any product presented in this course.

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Index Matching For Optical Excellence

ABO Approved Level II

Course Written by Andrew S. Bruce
LDO, ABOM, NCLEM, FCLSA

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Objectives

Upon completion, the participant should be able to...

Discuss refractive index and its significance, with regards to both lens materials and coatings.

Communicate the benefits that result when the refractive indices of the hard coating and lens substrate are closely matched.

Appreciate the benefits of recommending MR™ premium high index.

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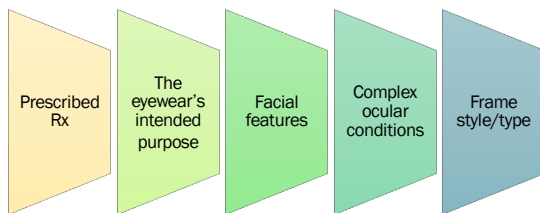


Recommending The Best Lens Material

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Which Material/Substrate Is Best?

Depends on...



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Refractive Index

Refractive Index, $n = \frac{\text{Speed of light in air, } c}{\text{Speed of light in second medium, } v}$

Refractive Index: Ratio between speed of light in air to speed of light in a second medium

- A measure of a medium's refractive properties
- Higher refractive indices = thinner lens
- Is all high index created equal?

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Not All High Index is Created Equal

Mitsui Chemicals is the world's major producer of the chemistry used to make the MR™ series of thiourethane-based, premium high index

- MR™ high index includes:
 - **MR-8™** (1.60 / Abbe 41)
 - **MR-7™ & MR-10™** (1.67)
 - **MR-174™** (1.74).



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Technologies

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38 YEARS OF PRODUCT INNOVATION

CrystalCoat™



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Benefits of MR™ Thiourethane Premium High-Index

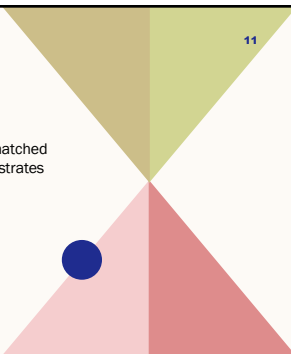


- Thin, light-weight lenses
- High Abbe values / heat distortion temp.
- Easy to tint / 100% UV attenuation
- Excellent mechanical strength
- Little to no discoloration, over time
- Superior coating adhesion/durability
- Index matched hard coatings

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Acrylic High Index

- Many incorporate hard coatings index-matched for low index resins, **NOT** high index substrates
- Creates an index mis-match
- Light perceives the coating-substrate interface as two separate entities
- Results in less-than-ideal outcomes.



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Key Benefits of Index Matching

1: Minimized Reflectance

- Light perceives the coating-substrate interface as a single entity
- The closer the index matching, the lower reflectance

2: Strong Coating Adhesion

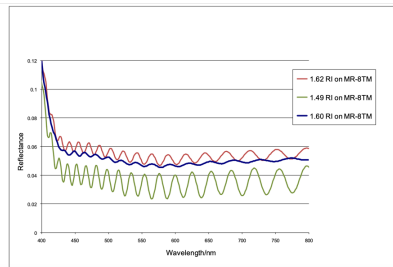
- Demonstrates superior durability in industry standard testing to withstand daily wear and tear

3: Minimal Birefringence

- Perceived single interface results in minimal birefringence
- Delivers optimal clarity and cosmetics.

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1: Minimized Reflectance

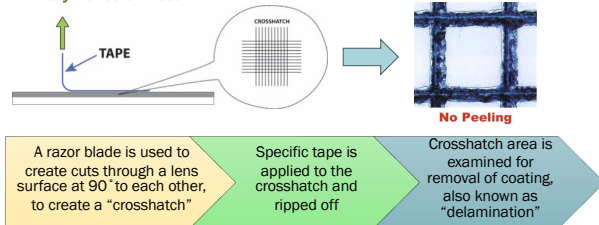


- A perfect index match would result in a flat line or zero reflectance
- Perfect index match not practically possible
- The closer the match, the lower reflectance, hence, a smoother line.

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2: Coating Adhesion Testing with MR-8™

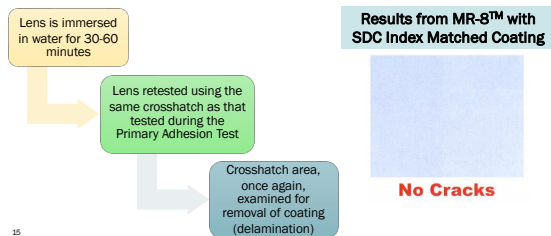
Primary Adhesion Test



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2: Coating Adhesion Testing with MR-8™

Boiling Water Test

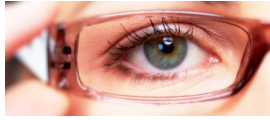


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2: Coating Performance Test Results

Hard Coating Refractive Index	1.60	1.66
Primary Adhesion Test	100%	100%
Boling Water Test (After 30 Minutes)	100%	100%
Bayer Test	3.7 (on MR-8™)	2.7 (on MR-7™)

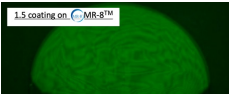


- Bayer Test & Bayer Ratio:
- Measures haze gain on coated lens vs. uncoated CR39 reference lens
 - Bayer ratio is a measure of the scratch resistance of a coated lens vs. uncoated reference lens.

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3: Minimal Birefringence

Mis-Matched Hard Coating



Significant birefringence

Index-Matched Hard Coating



Minimal birefringence

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How Do We “Index Match”?

Standard 1.49 index
hard coating is
silica based

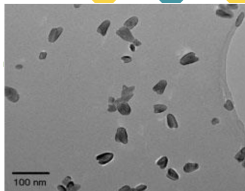


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How Do We “Index Match”?

Standard 1.49 index
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To increase its index,
metal oxides are
added to coating resin



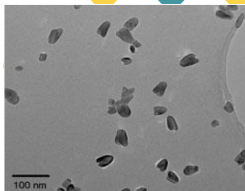
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How Do We “Index Match”?

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To increase its index,
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Mostly used oxides:
Titanium dioxide or
Zirconium dioxide



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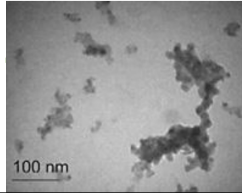
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Precisely controlled
addition prevents
nanoparticle
agglomeration

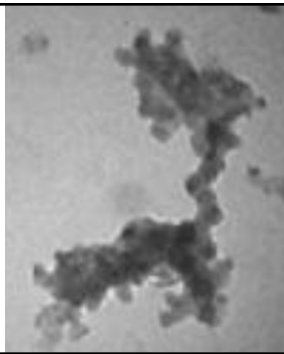


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Nanoparticle Agglomeration

- Clumping together of metal oxide nanoparticles
- Can result in degraded quality and “spotty” lenses
- MRT™ series hard coatings comply with strict QC standards
- Ensure great performing lenses.



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CrystalCoat™



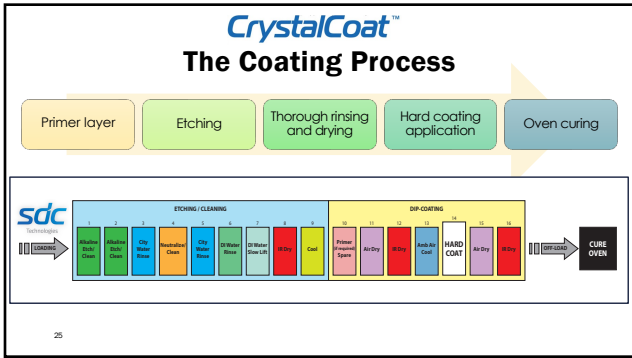
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Application Requirements

MRT™ substrates require:

- Contamination-free environment
- Primer layer or caustic etching under optimized conditions
- Sufficient cleaning to ensure complete caustic removal from the lens.

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Primary Roles Of A Hard Coating?

- Abrasion resistance
- Stable substrate for AR coating.

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Why Recommend AR Coated Lenses?

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Benefits of Premium AR Coatings

Multiple layers
minimize lens
surface reflections

Optimize light
transmission/
visual acuity

Enhanced
durability/long-
term performance

Complement
digital lens benefits

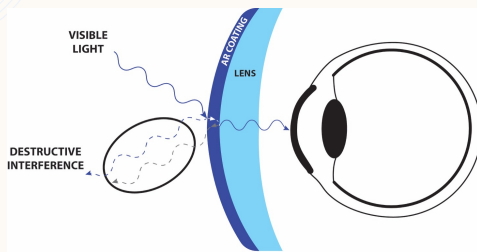
Easy maintenance
and excellent
warranties

Increased patient
satisfaction

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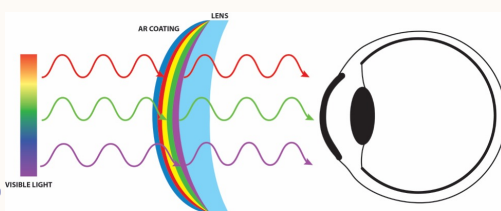
How AR Coatings “Do Their Thing”



AR layer thickness MUST be precisely $\frac{1}{4}$ wavelength of the incident light

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What About Premium AR Coatings?



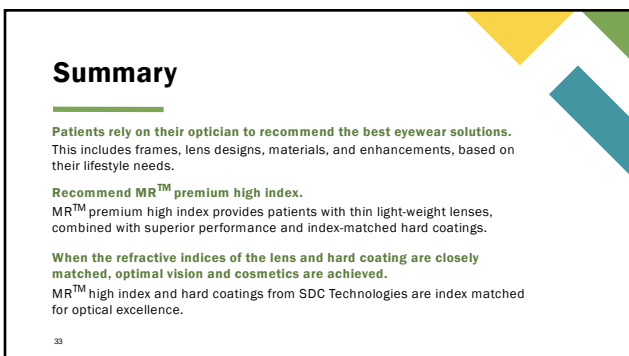
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Pop Quiz Time . . .

1. During the primary adhesion test, a razor blade is used to create cuts through a lens surface at 90° to each other. What do we call this cut area?
2. How is a lens material's refractive index increased?
3. Who is the world's major producer of the chemistry used to make MR premium high index lens materials?



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Any Questions?

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Thank you

For more information, visit the
MR™ High-Index Materials
LinkedIn Page:



This ABO Approved Course is supported by an
educational grant from Mitsui Chemicals.

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