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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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Which Material/Substrate Is Best?

Depends on…

- Prescribed Rx
- The eyewear's intended purpose
- Facial features
- Complex ocular conditions
- Frame style/type

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Refractive Index

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

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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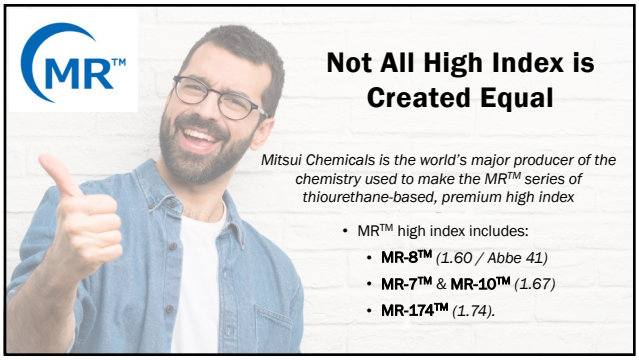

Not All High Index is Created Equal

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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sdc Technologies

sdctech.com

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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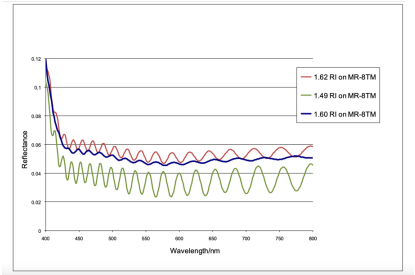
1: Minimized Reflectance



- 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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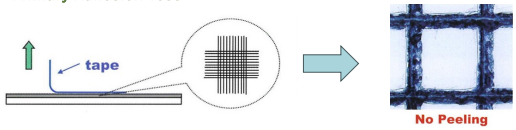
2: Coating Adhesion Testing with MR-8™

Primary Adhesion Test



No Peeling

A razor blade is used to create cuts through a lens surface at 90˚ to each other, to create a "crosshatch"

Specific tape is applied to the crosshatch and ripped off

Crosshatch area is examined for removal of coating, also known as "delamination"

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2: Coating Adhesion Testing with MR-8™

Boiling Water Test

Lens is immersed in water for 30-60 minutes

Lens retested using the same crosshatch as that tested during the Primary Adhesion Test

Crosshatch area, once again, examined for removal of coating (delamination)

Results from MR-8™ with SDC Index Matched Coating

No Cracks

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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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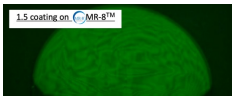
3: Minimal Birefringence

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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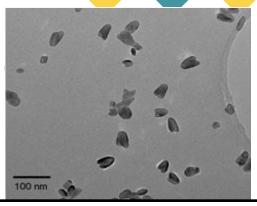
How Do We “Index Match”?

Standard 1.49 index hard coating is silica based

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



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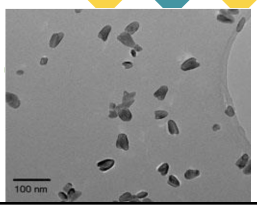
How Do We “Index Match”?

Standard 1.49 index hard coating is silica based

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

Mostly used oxides:
Titania dioxide or
Zirconia dioxide



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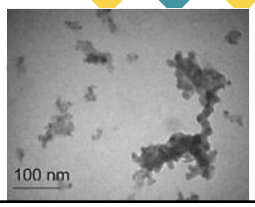
How Do We "Index Match"?

Standard 1.49 index hard coating is silica based

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

Mostly used oxides: Titania dioxide or Zirconia dioxide

Precisely controlled addition prevents *nanoparticle agglomeration*



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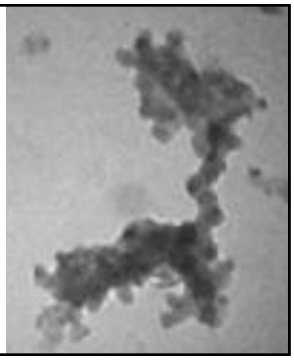
Nanoparticle Agglomeration

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



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CrystalCoat™

Application Requirements

MR™ substrates require:

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

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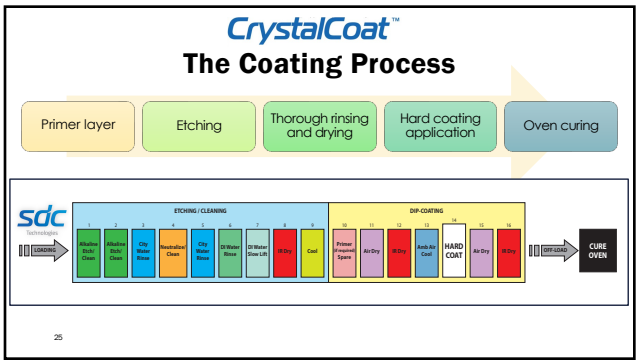
CrystalCoat™
The Coating Process
Primer layer
Etching
Thorough rinsing and drying
Hard coating application
Oven curing
sdc
ETCHING / CLEANING
DIP-COATING
HARD COAT
CURE OVEN
25

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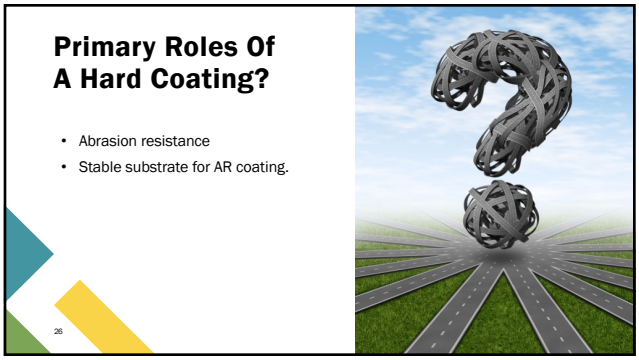
Primary Roles Of A Hard Coating?
• Abrasion resistance
• Stable substrate for AR coating.
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Why Recommend AR Coated Lenses?

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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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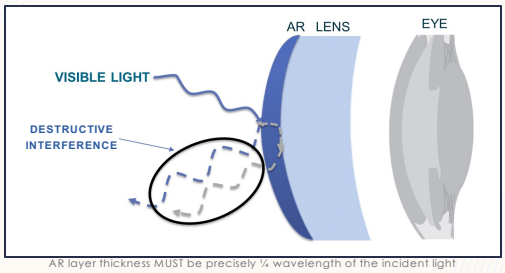
How AR Coatings "Do Their Thing"



AR layer thickness MUST be precisely ¼ wavelength of the incident light

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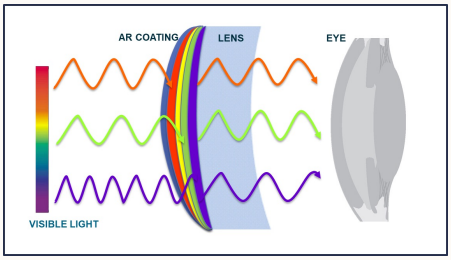
What About Premium AR Coatings



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MR™ Industry Prevalence

Adopted by Major Lens Makers

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Summary

Patients rely on their optician to recommend the best eyewear solutions.
This includes frames, lens designs, materials, and enhancements, based on their lifestyle needs.

Recommend MR™ premium high index.
MR™ premium high index provides patients with thin light-weight lenses, combined with superior performance and index-matched hard coatings.

When the refractive indices of the lens and hard coating are closely matched, optimal vision and cosmetics are achieved.
MR™ high index and hard coatings from SDC Technologies are index matched for optical excellence.

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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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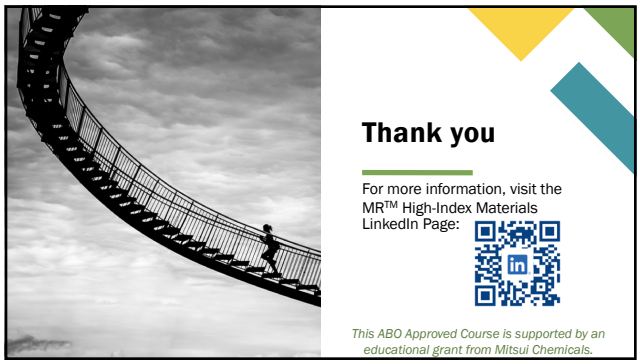

Thank you

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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