

## Boulder Optical Design

BoulderOpticalDesign.com

### Overview

Boulder Optical Design Inc. is dedicated to serving the optics industry with high-level scientific and technical support in optical physics. Our consulting services include thin film materials, thin film design, laser damage, optical measurement, mathematical modeling, and scientific writing.

### Consultant services

High-level scientific expertise and experience lead to faster and better solutions, and this can save you money and satisfy customers. We can support your scientific needs without bloating your overhead. We combine a deep understanding of the interaction of light and matter with strong scientific discipline and long experience in the optics industry.

### Examples of services that we provide

- Modeling a complex optical system, e.g. an interferometric interleaver for telecommunications, including detailed effects of thin film designs, dimensional errors, and material dispersion.
- Material choices and design for applications requiring high laser damage threshold.
- Create or review thin film designs and/or specifications for a complex optical system.
- Determine optical parameters for a coating material, based on spectrophotometer scans and other data. Extrapolate to other wavelengths where possible.
- Design and set up an experimental measurement of the group delay dispersion (GDD, sometimes also called group velocity dispersion) over a given wavelength range for an ultra-fast laser mirror.
- Design a thin film for an ultra-fast, controlled-GDD mirror.
- Optimize coating designs for improved manufacturability.
- Review and help write the scientific content on a grant proposal.

### Some of our specialties

#### Laser damage

The laser damage threshold of film coatings are often the limiting factor in high-power laser systems. Laser damage testing is usually done off-site, and is expensive and time consuming for both manufacturers and customers. This is clearly an area where some expert advice can save money. Dr. A. D. Streater has worked on

this problem over the last several years, resulting in many scientific papers and presentations on the subject. We can help with estimating damage thresholds for existing thin film designs and we can probably improve damage thresholds through changes in the design and/or materials.

#### Optical measurements

Experience pays off handsomely in designing and setting up a good optical measurement. We combine vast experience with a deep understanding of interference, diffraction, beam propagation, polarization and the theory of optical detection. We can design and/or build a system, and we can do it at a lower cost than others with less experience.

#### Thin film design

We have experience with traditional methods for designing multi-layer thin film coatings, and a deep understanding of the theory of light propagation in multi-layer thin film coatings that helps us think outside the box in cases where traditional methods fail. We also have a thorough understanding of the uncertainties in manufacturing processes, and can optimize designs accordingly.

#### Thin film materials

The manufacturing process for thin film optics can be greatly improved by a close match of the theoretical design with the measurement results after deposition. Better matching with theory is accom-

plished largely through a better knowledge of the optical properties of the thin film material. (See below.)

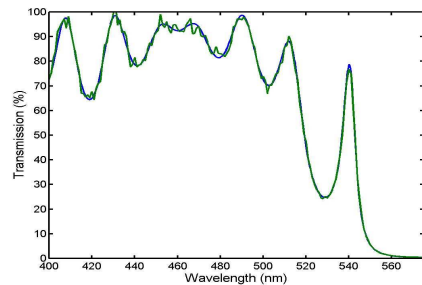
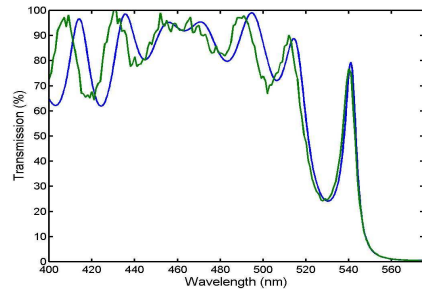


Figure: After the materials are well characterized, the design model and measured results agree. This improves the manufacturing process considerably.

Improved material parameters also ensures that the process “aims for the middle” and thus provides the most room for manufacturing errors. We use a combination of methods to accurately determine the index and extinction coefficients from measured data, and in many cases we can extend the wavelength ranges by using additional knowledge. Understanding the fundamental aspects of light propagation through optical media is very helpful in this synthesis process.

## Other services

There are many other services that we can provide faster, better, and probably cheaper because of our great experience and understanding of optical physics.

Examples of other services: Write or review scientific content for proposals and reports; Perform mathematical analysis and modeling for complex optical systems; Develop a mathematical model of your manufacturing process for better quoting; Develop or review specifications for an optical system in order to make it more manufacturable and cheaper.

## About Alan D. Streater

Alan D. Streater, president of Boulder Optical Design Inc., has a Ph.D. in physics (JILA/NIST, U. of CO). He has worked 2.5 years in postdoctoral research (Leiden University), in academics for 11 years specializing in the interaction of light and matter (Lehigh University Physics Department, tenured 1995), and in the optics industry for 10 years (Research Electro-Optics and Boulder Optical Design). Dr. Streater has 40 publications, including 4 patents (2 pending).

Dr. Streater has the clarity of a teacher, the depth of a researcher, and a practical approach that is essential in industry. His expertise includes light propagation, optical materials, laser damage, mathematical modeling, thin film optical design, thin film deposition, and optical measurements.

## Non-disclosure policy and integrity Statement

I will not disclose results, data, or techniques that are privately held by other companies or by your company. I will use and suggest solutions and techniques that are my own, or that are in the open literature, or that are standard in the optics industry. I can provide a list of references who can attest to my high standards of integrity, my scientific abilities, skills, and effectiveness.

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