Guest Editorial

Stray Light and Its Suppression

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Stray light presents a continuing problem to the optical engineer. It reduces image contrast, introduces spurious signals, and in cases where a strong extraneous source is present, can completely mask the light from a weak object. Attempts to reduce or eliminate scattered light are often empirical and usually not very successful. Recently, however, powerful analytical techniques such as GUERAP and APART have been developed to aid in system design. Using these techniques, which were described in a SPIE seminar on "Stray Light Problems in Optical Systems," and are now published in SPIE Proceedings Volume 107 (1977), significant advances have been made in optimizing baffle design and improving system performance. The computer models, however, are only as good as the data fed into them, and there is no substitute for accurate knowledge of the scattering behavior of optical surfaces and the performance of optical blacks.

Various sources of scattered light were discussed in a survey presented at the symposium and published in expanded form last year in *Optical Engineering*.[1] It was concluded that for optically polished surfaces, scattering from microirregularities was usually the most significant source of unwanted light in the ultraviolet, visible, and near infrared. Scalar scattering theory, which neglects polarization effects, gives a rather simple expression for the light scattered into all directions by these microirregularities when only a single surface is involved. However, most optical surfaces have multilayer coatings on them, which greatly complicates the scattering picture. In part these coatings contour the original surface. However, they also add some roughness themselves. Carniglia has addressed this difficult problem and has developed a simple matrix formulation for calculating the scattering from a multilayer film. The angular dependence and polarization of the scattered light are discussed in the following paper by Elson and Bennett, and the influence of various kinds of microtopographic features on the scattering performance of optical surfaces is investigated by Church, and also in a different context by Noll.

Knowing what microtopographic features are best is not the same as producing them experimentally, and Barnes and McDonough describe some of the procedures which have been used successfully to produce low scatter surfaces on difficult optics such as aspherics. Having produced good surfaces and coated them in such a way as to minimize additional scattering, we may now insert the components in an optical system. To calculate the scattering level in this system we must know the absorption characteristics of the optical blacks used to coat the baffles and interior surfaces of this system, and Stierwalt gives us a comprehensive survey of this difficult-to-obtain data.

If the optical surfaces have appropriate scattering characteristics and the baffles are well designed and coated with an appropriate optical black, the system should exhibit low scattering characteristics. There is always the problem of surface contamination, however, and in time even the best surfaces will deteriorate. To measure the extent of this deterioration is not an easy task, and Williams and Lockie suggest one simple and nondestructive technique for evaluating surface contamination as it affects scattering level, namely a BRDF measurement.

The combination of theoretical understanding and practical experience with optical surfaces represented in this special issue, together with the techniques discussed in SPIE Proceedings Volume 107, should prove most helpful in developing and maintaining low scatter optical systems. Other articles on stray light will appear in future issues. It is our hope that this information will see wide use. The result should be an increased ability to deal with the stray light problem in optics.

Our thanks go to the authors of the papers given here, to Editor John DeVelis for his help in keeping the issue on schedule, and to the various reviewers for their helpful and incisive comments. Special thanks go to Jean Bennett for her invaluable help in making it all happen.

1. H. E. Bennett, "Scattering Characteristics of Optical Materials," Optical Engineering *17*, 480 (1978).