OMEGA OPTICAL

Custom Filters from Prototype to Production

TECHNICAL NOTE

Blocking in an Optical Filter

How to Specify Blocking in an Optical Filter

To understand blocking, one has to understand the concept of optical density (OD). OD is equal to 2-log(%T). This relationship is illustrated in Figure 1 and in the table. Note that OD is a log scale. Many researchers are familiar with the OD (or absorbance) used in colorimetric assays or chemistry experiments to calculate the concentration of a compound using Beers Law. By contrast, in an interference filter, almost no light is absorbed by the materials from which the filter is made. OD is generated by reflecting unwanted light back instead of letting it go through the filter. In an enclosed assembly, this light can bounce around in unexpected ways. OD effects are additive, so you can increase the blocking of your system by adding additional filters to the light path.

Percent Transmission	OD
100	0
10	1
1	2
0.1	3
0.01	4

The other aspect of blocking that is important is the wavelength range. If you are trying to block a specific excitation laser wavelength, blocking is only needed over a narrow range. If your signal is only at higher wavelengths to your laser, you have the option of using a long-pass filter which might be a cheaper option for your application. If you are trying to detect a laser signal in the presence of a lot of background light (for example, in a LIDAR application), you need blocking over a large wavelength range (most of the visible spectrum in this case).

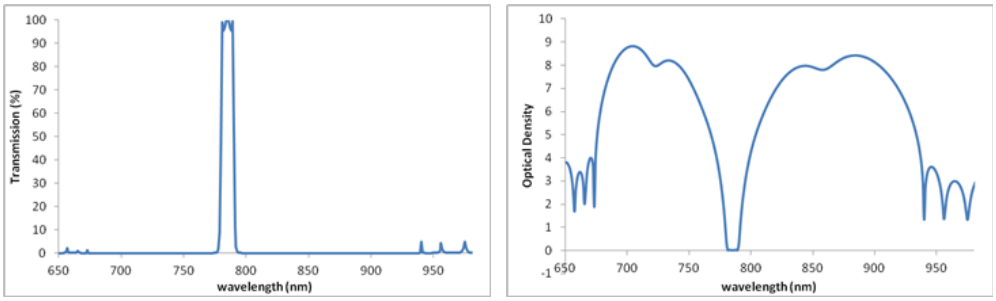

Figure 1. On the left is a spectral response curve that depicts percent transmission, on the right is the same response plotted as a function of OD. Often, the OD curve is "upside down" so the least light is passing through the highest OD values.

Another factor that will affect the wavelength range is the type of detector you are using and its spectral response curve.

A customer needs to combine the two main concepts to fully describe the blocking they need in their application. For instance, in a flow cytometry application, the customer will need high blocking (OD6 minimum) at the laser excitation wavelength (which is strongly scattered by the sample), with moderate blocking (~OD4) of competing fluorescence signals (autofluorescence, for instance) at other wavelengths that are not in the filter's transmission region. Note that measuring high OD is difficult with standard spectrometers. The measurement begins to deviate from the modeled response at OD 4-6, depending on the type and settings of the spectrometers used to measure the filter. Request our paper "Laser-based assessment of optical interference filters with sharp spectral edges and high optical density" for more information.

Omega has the expertise to ensure you have the right amount of blocking for your application. Minimize your cost by carefully choosing the amount and range of blocking you need.

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