

## Thin Film Absorption Loss Characterization by Focus Error Thermal Lensing

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We present a simple method to measure absorption loss in thin film dielectrics. The absorption characterization method is a photothermal technique based on thermal lensing. The method measures the defocusing of an incident probe beam caused by a thermal lens generated by absorption of the incident pump beam. The specific application is for thin films deposited on fused silica substrates. The concept of the method is simple. The pump beam is selected specifically to match the wavelength at which one desires to know the absorption. In the case of a thin film on a substrate, the absorption in the thin film acts as a heat source that causes a temperature increase of the substrate. Since the refractive index of the substrate changes with temperature this acts as a lens focusing a probe beam of shorter wavelength that passes through the whole thickness of the substrate. Thus the final focus of the probe beam is altered by the absorption of the sample. Quantifying the change in the focal plane of the probe beam allows the determination of the sample absorption. This is done using a four-quadrant detector and cylindrical lenses to generate a focus error signal. The technique has a sensitivity of less than 10 ppm absorption @1064nm wavelength. Sensitivity is limited by the bulk absorption of the substrate. Excellent results were obtained with both amplitude modulated and pulsed pump laser beams. One of the main advantages of the technique is that the pump beam does not need to be tightly focused on the sample and the detection scheme can be placed far away from the sample (a collimated probe beam is used).