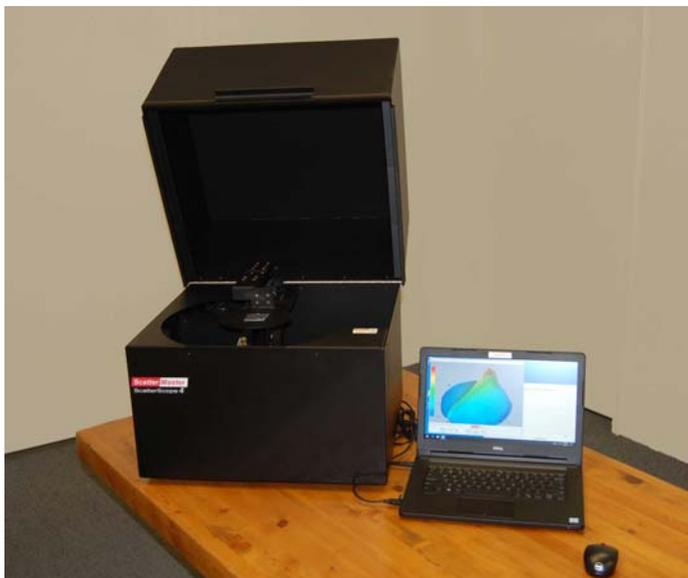
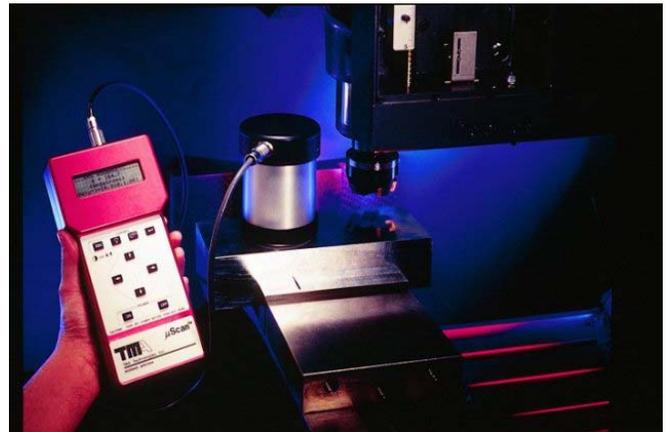


## An Overview of Scatterometers Available from TSW

The following instruments are offered for sale by The Scatter Works, Inc (TSW). They vary greatly in both price and capability. User choices need to be dictated by user requirements. For example, all of the instruments can be purchased with different wavelength sources. This document is only an overview, but will help you narrow the search. They are organized roughly in order of increasing price and capability. Use the summary chart on the next page. Call or email TSW to get more detailed information and/or quotes.

The **MicroScan** is a simple single diode laser three detector scatterometer manufactured by TSW. The system measures specular reflectance at an incident angle of 25 degrees and scattered light at angles of 0 and -50 degrees. Under the assumptions that the surface is optically smooth and isotropic values of the rms roughness from 0.01 to 1.0  $\mu\text{m}^{-1}$  is reported in addition to the associated TIS. The noise floor is about  $10^{-5}/\text{sr}$ . It has been used to monitor the aging of large optics. The price is \$9,000.



The **ScatterScope4** is a table top instrument manufactured by ScatterMaster LLC in Tucson AZ. It uses multiple silicon detectors that scan 180 degrees to measure hemispherical and incident plane scatter in both reflection and transmission. It can be equipped with as many as three laser diode sources. It does not measure close to the specular beam and the noise floor is limited to the  $10^{-5}/\text{sr}$  to  $10^{-6}/\text{sr}$  range. It's huge advantages are speed (15-20 seconds per scan) and ease of use. Operators can be trained in a few minutes. It is an ideal instrument for the lighting industry. A single red laser system is priced at about \$55,000. An RGB system is closer to \$100,000. Call for quotes.

The **CASI Scatterometer** (below left) is a TSW research instrument that can be configured with multiple laser sources ranging from the near UV to the mid-IR. It uses programmable collection apertures and step sizes to allow measurements within 0.1 degrees from the specular beam and it has a noise floor of about  $10^{-8}$ /sr in the visible, which is limited by scatter from air molecules. It takes a linear incident plane scan at a programmable incident angle. It requires a lab with an optical table (not supplied) and benefits from hepa filter air flow for some applications. Operator training takes about a week. A single red laser system costs \$190,000.



The **TASC Scatterometer** above right is essentially a CASI that takes hemispherical measurements with manually changed apertures. UV, visible, mid-IR and broadband systems have been built. A single red laser system is \$250,000.



The **TTS Scatterometer** (left) is a table top research instrument manufactured at IOF in Jena Germany. It measures in both the incident plane (five minutes) and hemisphere (one or more hours) from the near UV to the near IR. Measurement near specular is limited to 1-2 degrees depending on sample scatter levels. The noise floor is limited by air scatter to about  $10^{-8}$ /sr. The price for a three laser RGB system is about \$250,000.

The chart below compares the five scatterometers. While there is obviously some duplication in capabilities, they all have unique features and in that sense are not really competitors.

	MicroScan	ScatterScope4	CASI	TTS	TASC
Manufacturer	TSW	ScatterMaster	TSW	IOF	TSW
Incid Plane Meas	5 sec	15 sec	5-10 min	5-10 min	5-10 min
Hemispherical Meas.	No	15 sec	No	1-5 hour	1-5 hour
Auto TIS	Est.	Yes	Est.	Yes	Yes
Near UV to Near IR	Yes	Yes	Yes	Yes	Yes
Mid IR	No	No	Yes	No	Yes
Visible NEBRDF	10 E-6/sr	10 E-6/sr	10 E-8/sr	10 E-8/sr	10 E-8/sr
Near Specular	NA	5-10 deg	< 0.1 deg	< 2.0 deg	<0.1 deg
Price Single Red Laser	\$9K	\$55K	\$190K	\$210K	\$250K

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