

Harmonisation of two nanosecond laser induced damage testing facilities at 1064 nm in vacuum and ambient pressure

The international standard for laser-induced damage threshold (LIDT) testing of optical coatings is built on regular inter-laboratory comparisons, so called round-robins. In 1983 and 1997 such experiments were conducted at the fundamental wavelength of the Nd:YAG laser under atmospheric conditions settling the international standard as it is known today. In 2013 DLR, LZH, University of Vilnius and ESA extended this comparison to LIDT measurements in vacuum. One of the major contributors to the uncertainty of the measurements was the sample-to-sample variation of the same batch, as well as the different pulse durations used. Applying scaling laws seemed to be difficult, as they are not determined to the level of precision necessary. To establish a higher level of confidence in the correlation of both DLR and ESA's LIDT measurement facilities, tests were conducted on the same sample at identical pulse duration of 10 ns at a wavelength of 1064 nm. Furthermore the same type of diode pumped, injection seeded laser was used. These measures limit the number of tests that we are able to directly compare, as each facility has to test a significant area on each samples (>100 sites). Four samples have been compared with the S-on-1 method according to ISO21254-1, two AR1064/0° windows and two silicon wafer. The total variation of the 0% damage probability values after 10000 shots is less than 20%, which is well within the 2σ uncertainty, both laboratories calculate individually. The obtained level of agreement of the measurements is, to our best knowledge, the closest agreement of two ISO21254-1 nanosecond LIDT testing facilities. To achieve this high level of confidence both facilities did undergo a deep mutual review process of all used measurement and analysis methods. Within the scope of this review activity the ESA optoelectronics laboratory achieved ISO17025 accreditation and got the accreditation for measurement of "Laser Induced Damage Threshold Measurements" according to ISO21254 series accredited by RvA (Dutch accreditation council) under L412. In this paper we will discuss the difficulties of performing comparable laser damage testing as well as a detailed analysis of the measurements conducted on the samples for this harmonisation activity.