European Metrology Research Programme

Delivering Impact

Supporting the Belgian diamond industry

Antwerp has been a trading hub for the diamond industry for several centuries, and is regarded by many as the world's diamond capital. In 2013, 84% of the world's rough diamonds were traded in Antwerp, with a total value of $55 billion. The income and jobs generated make the sector of crucial importance to the Belgian economy; consequently, preserving Antwerp's world-class reputation in the characterisation of cut diamonds is vital.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

With the growth of diamond trading hubs in India and China, an improved infrastructure is needed to support the classification of cut diamonds at the highest standards and preserve Antwerp's world-class reputation. This will give traders greater confidence in the diamonds they buy and sell in Antwerp, encouraging trade and strengthening Belgium's position in a competitive high-value market.

The dimensions and angles of the facets of a cut diamond affect the level of optical reflection which gives a diamond its brilliance. This ability to scatter light is a major contributing factor to a diamond's value, and cut diamonds are routinely evaluated by measuring facet profiles. To ensure the accuracy of these measurements, commercially-available diamond-measuring instruments must be regularly calibrated using reference diamonds of known dimensions and angles. The reference diamonds themselves are measured using highly-accurate micro co-ordinate measurement machines.

According to Hugo Piree, from the Division Metrology SMD-ENS of the Federal Public Service (ministry) Economy of the Belgian government, the Belgian diamond industry needs to be able to measure these reference diamonds to within an uncertainty of better than 300 nm (0.0003 mm) to guarantee the quality and value of its products. To achieve this level of accuracy, the uncertainty with which micro co-ordinate measurement machines can measure reference diamonds needs to be reduced.

Solution

Using methods that were developed in the EMRP project *Optical and tactile metrology for absolute form characterisation,* reference standard surfaces were measured using both an optical measurement machine from the Belgian Diamond Research Centre and a high accuracy tactile precise measurement machine at the Belgian Metrology - National Standards Institute, leading to a linking of methods and a reduction in their dimensional uncertainty to less than 150 nm. Improved measurement strategies were derived and will be used to form the basis of a new dimensional diamond characterisation method.

Impact

SMD-ENS and instrumentation company AC Optomechanix are developing a new scanning contactless measurement head for the Zeiss F25 micro co-ordinate measurement machine routinely used to measure the facets of cut diamonds. Using well characterised reference diamonds and the project's improved measurement strategies, they have been able to optimise their measurement head during the design stage. It is anticipated that this improved head will achieve uncertainties of less than 150 nm for routine measurements, exceeding the expectations of the Belgium diamond industry, and paving the way for more accurate distinctions between the various diamond grades. When the new measurement head is introduced into routine measurements diamond purchasers will be able to have greater confidence in certified diamonds based on greater metrological rigour. This in turn will reduce challenges to a diamond's grading and further enhance the reputation of the Antwerp diamond market.

Metrology for the photonics industry

The EMRP project *Optical and tactile metrology for absolute form characterisation significantly* improved the absolute form measurement of optical components – ranging from flat surfaces to aspherical and free-form surfaces. Different physical probing principles were combined and compared to develop improved measurement techniques, tools and standards which support the accurate measurement of optical surfaces. These capabilities will lead to the design of better optical components and systems, which can be manufactured with less energy and waste, and help strengthen Europe's position in the global photonics market.

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