TRIMOS

APPLICATION NOTE

Hip Implants – Quantification of Surface Quality

Hip replacements have become one the most common orthopaedic procedures over the past 50 years. Surface finish of joint bearings is a key parameter to ensure sustainable wear as well as reliability and body compatibility.

Only a strict control of the joint surface with quantification of its quality can ensure a proper operation over the entire life cycle.

Trimos offers new solutions for a quick and non-destructive surface finish control with subnanometric resolution.

Swiss Measuring Instruments

Introduction

In 2011, over 1 million hip replacements were performed worldwide [1]. This trend is expected to continue in the next decades due to ageing population and improving medical care in developing countries.

Abrasion and wear resistance is one of the major challenges for long term stability of artificial joints. The release of metal particulate debris can trig inflammatory responses and lead to bone resorption and aseptic loosening [2]. Intense research efforts continue to develop new designs and materials as well as manufacturing methods to produce more biocompatible and wear resistant implants.
Being able to analyse and quantify their surface texture plays a key role in achieving this objective.

Metrological Challenge

Prosthetic joints are usually highly polished surfaces of different materials such as metals, ceramics, polymers and in a near future even nanocomposites. Characterising these surfaces requires a highly accurate and non-destructive technology. Until recently, the only instrument able to perform such analysis was a human eye. Today, harsh requirements of medical regulations, traceability needs and process standardisation demand the quantification of surface properties.

Measuring Surface Texture

Trimos is now able offer a specific solution for the medical industry. The TR Scan Premium equipped with its specially designed DHM S3 (Digital Holographic Microscopy) measuring head allows the retrieval of the full three dimensional surface information with nanometric resolution from a single image acquisition (no vertical scanning needed).

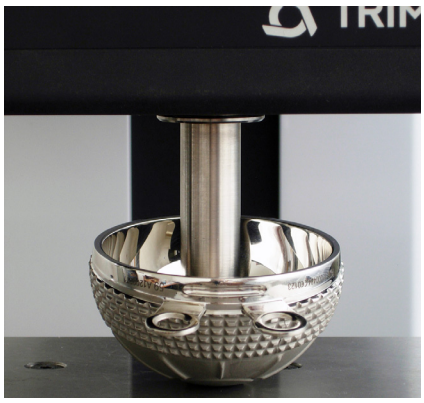

Figure 1
Measurement of an acetabular cup with DHM S3

Acquisition time of a few microseconds makes DHM® systems insensitive to external vibrations and thus easy to operate.

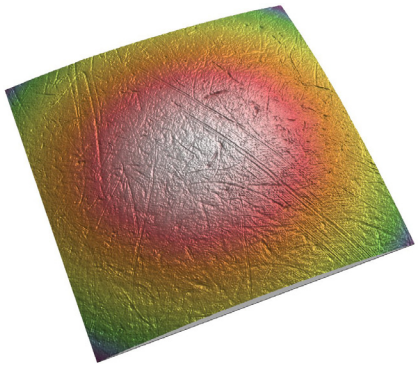

Figure 2
Femoral Implant Head - 3D view of the surface texture

Thorough Surface Analysis

Three dimensional surface characterisation provides far more information about its spatial structure than classical 2D profile measurement.

The recently published international standards collection ISO 25178 offers new analysis tools and parameters for surface quantification.

ISO 25178		
Height Parameters		
Sa	7.54	nm
Sz	296	nm
Sq	10.5	nm
Ssk	-2.03	
Sku	23.0	

Table 1
Examples of typical 3D Parameters according to ISO 25178

DHM is a recognized surface texture measurement method according to the standard ISO 25178-6.

References

[1] OECD, "Health at a glance 2011," Report, OECD Publishing, 2011

[2] European Commission, Joint Research Centre, "Total Hip Arthroplasty- State of the Art, Challenges and Prospects", 2012

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Instrument	TR Scan Premium
Measuring Head	DHM S3
Vertical resolution	0.1 nm

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750 04 0001 03 - V 1.0 / 2013-05