Determination of nitrogen layer thickness of push belt rings by GDOES

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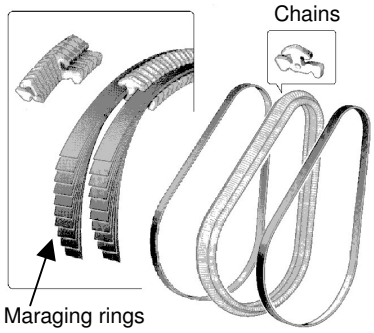
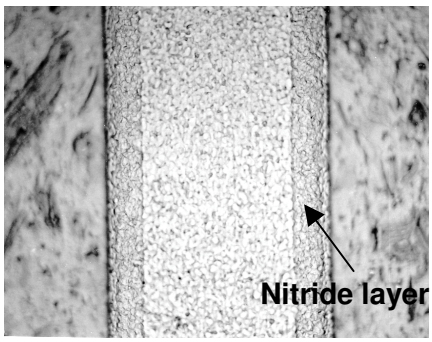
Introduction

Van Doorne's Transmissie (VDT) produce push belts that are implemented in the Continuously Variable Transmission (CVT) of cars. The push belt contains both chains and maraging rings, as shown in the picture:



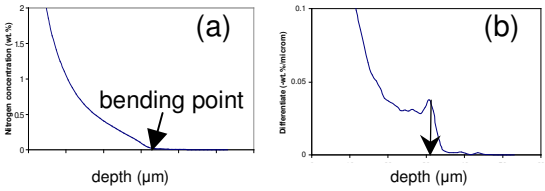
Due to the high friction, the rings require a high fatigue strength, which is obtained by a nitriding process in our production. Currently, we are controlling the nitrogen layer thicknesses by etching in combination with optical microscopy. A micrograph is given in the following picture:



In the near future, we would like to control this nitrogen layer by measurements with our new GDOES equipment.

Method

An example of an GDOES measurement of a nitride profile is given in figure (a) below:



The nitride profile contains a bending point. The position of this bending point is defined as the nitrogen layer thickness. Figure (b) presents the first deviate of the concentration profile, indicating the bending point more clearly. Probably this bending point is caused by a transition of nitride dispersions.

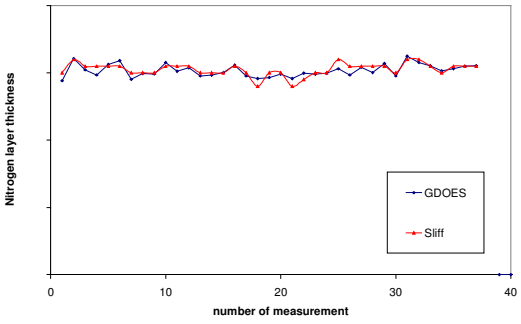
The nitrogen layer thickness has to be determined within an accuracy of one micrometer. The GDOES-software is not able to determine the thickness within this accuracy. Therefore the apparent thickness, as measured by the GDOES, is corrected by the following equation:

$$d^{corrected}_{nitride\ layer} = \frac{d^{perthometer}_{crater}}{d^{GDOES}_{crater}} \cdot d^{apparent\ GDOES}_{nitrite\ layer}$$

After this correction, the accuracy is considerably improved form ~3 µm to ~1 µm.

Results

A number of nitrided maraging rings were measured both by the optical method and by the GDOES, as shown in the figure below. The figure indicates that the results of the GDOES measurements are comparable with the optical measurements.



Conclusions

- The GDOES is capable to measure the nitrogen layer thickness in our product within the required accuracy.
- The GDOES measurement is faster and more accurate than the current optical method.

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