Automated Rockwell indentation test for the evaluation of coating adhesion

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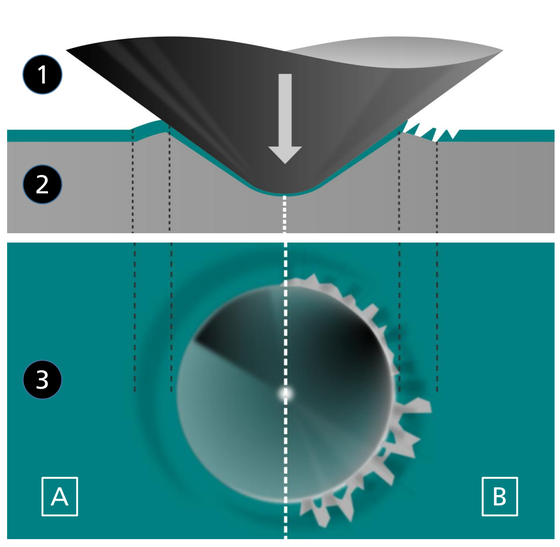
INTRODUCTION

The overall objective of the project AUROS is to move the Rockwell indentation test for evaluating the adhesion of hard coatings from a subjective assessment to an objective measurement and to prepare the results for standardization.

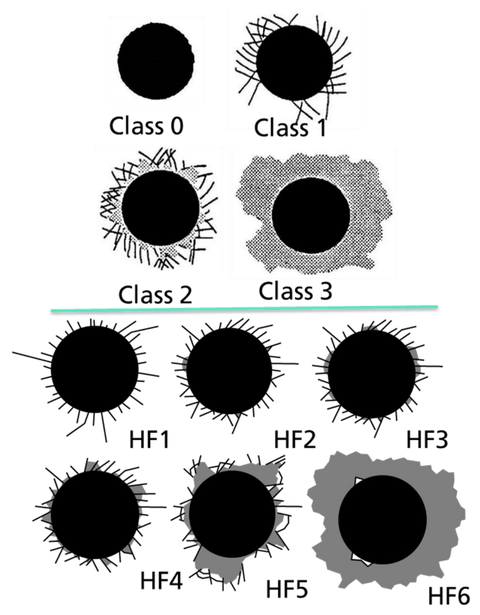
Coating adhesion is one of the most important parameters for evaluating the quality and functional reliability of thin-films. The Rockwell indentation test is an established test method in industry and research for determining coating adhesion

PROCEDURE

A hardness indentation according to Rockwell C is performed on the coated component. Any damage of the coating around the indent is qualitatively assessed and classified into adhesion classes (ISO 26443 or DIN 4856).



Schematic drawing: 1 Rockwell indentor;
2 and 3 Coated component;
A: No delaminations → good adhesion
B: Delaminations → poor adhesion.



Schematic drawings: Adhesion classes ISO 26443 (top) and DIN 4856 (bottom).

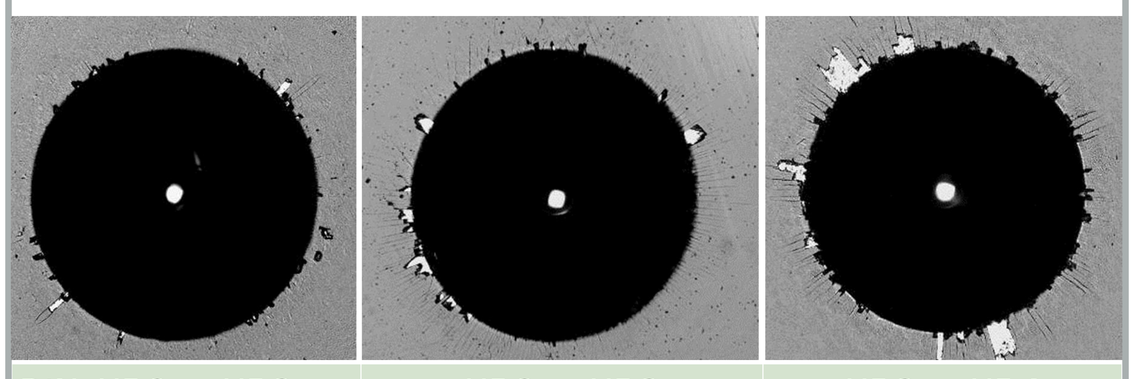
Advantages: Very simple and fast test method.

Disadvantages: Experienced personnel is necessary.
Depending on the experience of the person, the result may be different.

PROBLEMS OF THE ACTUAL SUBJECTIVE EVALUATION

514 Rockwell tests were carried out and evaluated by three companies:

- At 76 % of the indentations, the different persons assigned different adhesion classes. This concerns HF 2, HF 3 and HF 4.
  - In 287 cases: deviations of *one* adhesion class (see below)
  - In 52 cases: deviations of *two* adhesion classes.



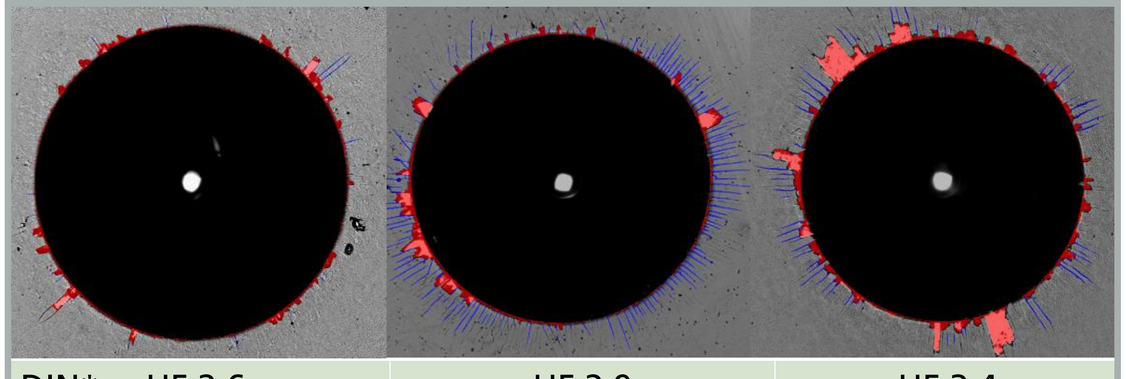
DIN: HF 2 or HF 3	HF 2 or HF 3	HF 3 or HF 4
ISO: Class 2	Class 2	Class 2

AUTOMATED ROCKWELL TEST TO EVALUATE COATING ADHESION

- New instrument for the automated execution of the Rockwell indentation and the microscopic picture.
- Detection of coating failures and major cracks around the indent.
- Automated and AI-based classification of coating adhesion class.
- DIN classes are given with one decimal (see pictures below)*.
- Enabling data extraction for quality management and Industry 4.0.

New instrument for automated Rockwell indentation test including microscopic picture recording, developed and built by BAQ GmbH.

AUTOMATED EVALUATION RESULT



DIN*:	HF 2.6	HF 2.9	HF 3.4
ISO:	Class 2	Class 2	Class 2

Cracks (blue) and coating failures (red), identified by AI-based image analysis.

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