Success Story
COMET

MPPE
Materials, Processing and Product Engineering
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K2-Centres
COMET subproject, duration and type of project:
Cutting tools - Coatings (A5.16-03), 01/2012-12/2014, multi-firm

Novel characterization techniques for coatings

Within a collaboration of several research institutes in Leoben with the company CERATIZIT Austria in Reutte, a portfolio of characterization techniques for thin functional coatings has been developed. These techniques allow hitherto impossible insights into the interaction of growth conditions, the resulting coating composition and the properties of the coating. The work of the Materials Center Leoben and its scientific partners in this field has recently achieved a high international reputation.

Coating design - the way to success of tools

Modern high-performance tools need to fulfil a huge variety of demands. For example, the tough base materials required for tools are often combined with hard and wear-resistant surface coatings. The further development of coating materials poses huge challenges on synthesis and characterization, often on the atomic scale. The necessary characterization methods provide the basis for a knowledge-based property design of modern coating materials, as they are required for severe machining processes or also for micro-electronics devices.

Strong together - Scientific institutes of Leoben collaborate with industry

For several years, the Materials Center Leoben has been developing modern methods to characterize high-performance materials. Within a collaboration of the Chair of Functional Materials and Materials Systems, the Chair of Materials Physics and the Chair of Physical Metallurgy and Metallic Materials of the Montanuniversität Leoben with the company CERATIZIT Austria in Reutte, a portfolio of characterization techniques for thin functional coatings has been developed.

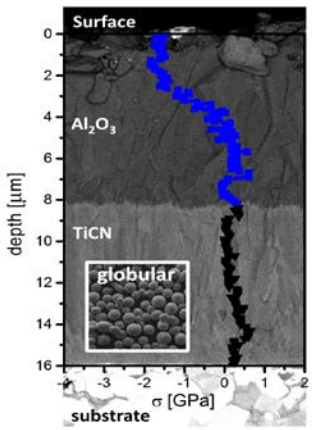

Fig. 1: Residual stresses in a bilayer hard coating with compressive stresses optimized for cutting applications.

These techniques allow hitherto impossible insights in the interaction of growth conditions, the resulting coating composition and the properties of the coating.

bmwfw Federal Ministry of Science, Research and Economy
bmvit Austrian Ministry for Transport, Innovation and Technology

New characterization techniques enable new coating designs

The portfolio of methods includes 3D-atom probe tomography, electron back-scatter diffraction and X-ray nano-diffraction via synchrotron radiation, enabling the analysis of the chemical composition and the crystalline structure with a resolution in the nano-meter range (Fig 1). Mechanical and tribological test setups coupled with in-situ characterization methods give valuable information on the response of the material to severe mechanical and thermal loading.

Newly developed micro-mechanical tests on free-standing coatings allow to measure hitherto unmeasurable material properties, such as fracture toughness and ultimate strength of the coating (Fig. 2).

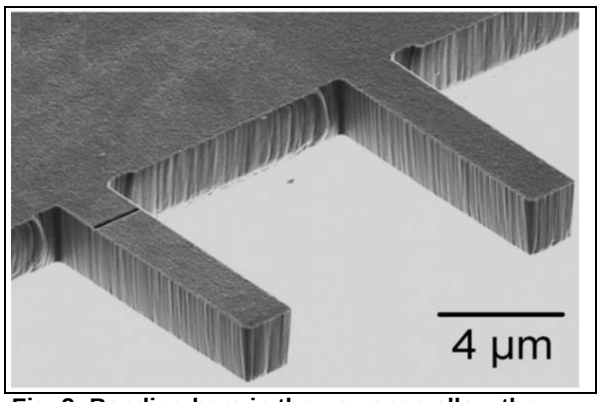

Fig. 2: Bending bars in the µm range allow the determination of the coating material characteristics (published)

Material properties such as the thermal expansion coefficient, specific heat capacity, thermal diffusivity and conductivity can be measured via high temperature bending bars combined with X-ray diffraction methods and thermo-reflectance.

This pool of ready to use methods in Leoben is unique in the world and represents a key to the development of modern high-performance coatings for application in tooling technology and in micro-electronics.

The world is looking at Leoben

The work of the Materials Center Leoben and its scientific partners in this field has recently achieved a high international reputation: At the high-light seminar of the International Union for Vacuum Science, Technique and Applications (IUVSTA) on October 25th, 2015 in San Jose, CA, the Leoben activities on synchrotron nano-diffraction have been presented as a major break-through in the research on the microstructure of thin films by Prof. Ivan Petrov, University of Illinois at Urbana-Champaign, (chair of the IUVSTA Surface Engineering Division).
In January 2016, an invited (!) publication on the developed portfolio of characterization tools has been published in the renowned journal "Surface and Coatings Technology". First author was Michael Tkadletz, PhD student at the Chair of Physical Metallurgy and Metallic Materials (Fig. 3).

Fig. 3: Michael Tkadletz

Contact and information
MPPE/ A5.16 - 03 „Cutting tools - Coatings“

Materials Center Leoben Forschung GmbH (MCL)
Roseggerstrasse 12, 8700 Leoben
0043 3842 45922-65
mclburo@mcl.at, www.mcl.at

Project coordination
Dr. Christian Tritremmel

Project partners

Organisation	Country
Ceratizit Austria GmbH	Austria
Ceratizit Luxembourg S.à.r.l.	Luxembourg
SuCoTec AG	Switzerland
Montanuniversität Leoben	Austria
Erich Schmid Institut für Materialwissenschaft	Austria