Project name:	**High Temperature Determination of Residual Stresses in Coated Cemented Carbides**

Beamtime Report

18.11.2013 – 22.11.2013 *(Date of the report: 03.04.2014)*

General information

Name of the rapporteur	**Name of the rapporteur's organisation**
Prof. Dr. Jose Garcia	AB Sandvik Coromant R&D
Type of research (nanotechnology/health care/chemistry etc.)	**Name of the research facility**
Material Science and Engineering	Helmholtz-Zentrum Berlin, Synchrotron Radiation Facility BESSY II, EDDI - Energy Dispersive Diffraction Station
Date of the measurement, duration	**Location of the event**
18.11.2013, 4-5 days	Berlin
Facility personnel participating in the measurement	
Dr. Manuela Klaus, Dr. Rodrigo Coelho and Dr. Daniel Apel	

Description of the project

Research description (short summary as written in the application)
Coated cemented carbide inserts are widely used as cutting tools for machining of metallic alloys. The substrates are coated with wear resistant thin monolayers or multilayers (i.e. Ti(C,N), (Ti,Al)N and Al2O3) by vapor deposition methods. In interrupted cutting machining, the cutting tools are subjected to load and heat impacts, which influence the wear type of the tools. In particular in milling operations the strong mismatches of coefficient of thermal expansion (CTE) between the coatings and the cemented carbide substrates may lead to the development of residual stresses during the thermo-mechanical cycling conditions, which may accelerate the formation and propagation of i.e. thermal cracks and failure of the tools. It is the aim of this project to measure in-situ residual stresses in both the coating and the substrate at different temperature levels and to track the stress distributions as function of temperature. In order to obtain information of the coating/substrate system synchrotron radiation need to be used.
Summary of activities (experiments performed, beamtime used, preliminary overview of results, next steps and other relevant information)

Part-financed by the European Union

Results of this investigation aimed at understanding the role of residual stresses on the deterioration of cutting tools as well as to design substrate/coating combinations with better resistance to thermo-mechanical loads. The information obtained from the measurement time helped to understand the effect of thermal loads in the cutting tools. This input can be used to optimize the coating/substrate design of the tools to enhance their cutting tool performance. It is important to highlight that these measurements were conducted in the simplest configuration for thermal stress analysis. Here any influence involving coating oxidation, texture formation and gradients in chemical composition were not taken into account. Further collaboration between AB Sandvik Coromant R&D and HZB is planned in order to better understand residual stress evolution in single layer and multilayers coatings and the influence on their properties in the different stress stages of the sample.
How would you describe cooperation and assistance from industrial liaison officers and national contact points while preparing and carrying out the research at large scale facilities?
Our impression is that there was a very good support in the preparation and execution of the project from the management of Science Link. The network is of great importance for the industrial partners in order to have access to measurement time but also contact with high skilled scientists on the field of high energy radiation.
Other personal remarks
We would like to thank Dr. Rodrigo Coelho for his support within the Science Link Programme and to Dr. Manuela Klaus, Dr. Rodrigo Coelho and Dr. Daniel Apel for their support in the measurement time at Helmholtz-Zentrum Berlin, Synchrotron Radiation Facility BESSY II, EDDI - Energy Dispersive Diffraction Station

Annexes

Annexes (list of annexes; meeting minutes, graphical illustrations, tables and other supplementary data)

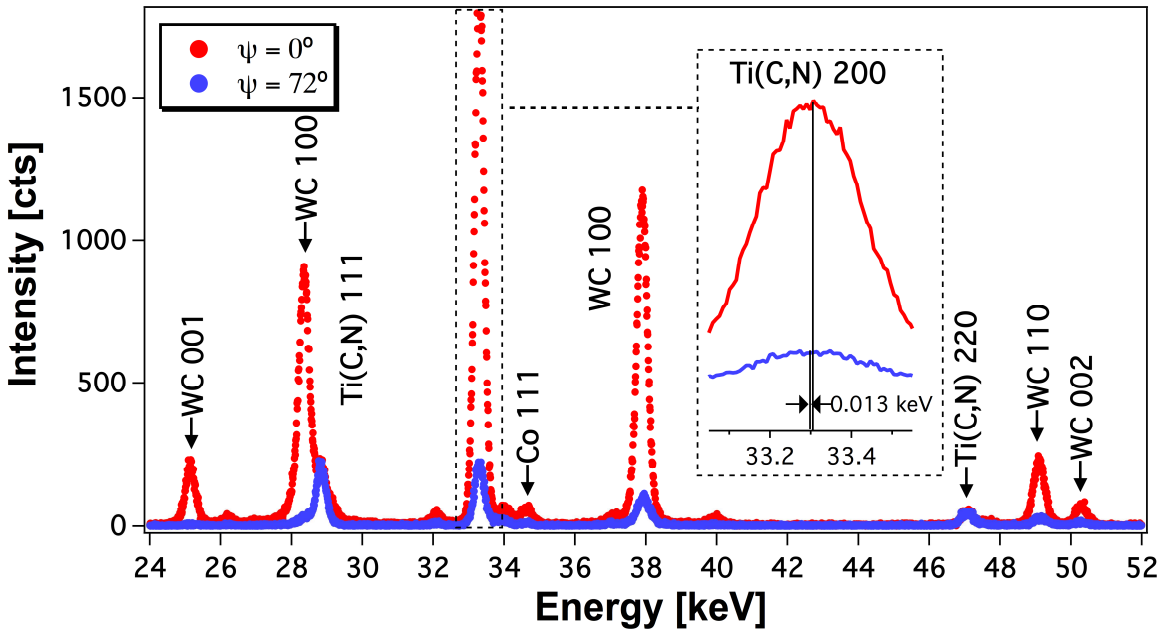

Fig.1 – Energy dispersive diffractograms showing the displacement of the peak position for two different psi positions (0° and 72°) during the sin2psi analysis.

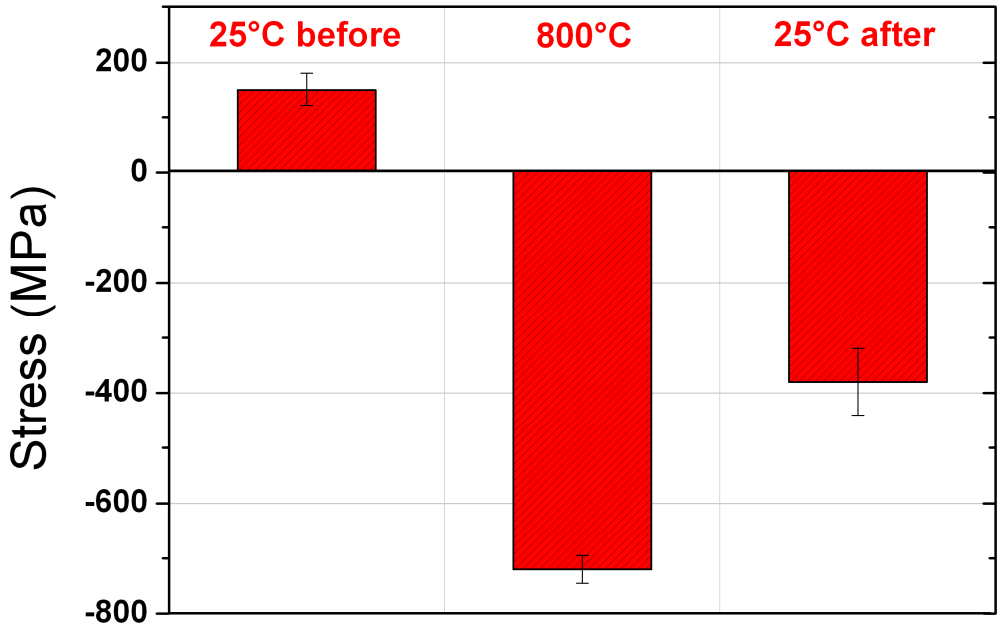

Fig.2 – Summary of residual stress analysis of the Ti(C,N) coatings during the heating tests: at room temperature before, at high temperature and after the treatment.

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