

Workshop »Coatings for Tools & Components«

CVD TiAlN coatings for cutting tools – state of the art and current challenges

Dr. Dirk Stiens¹, Dr. Thorsten Manns¹, Dr. Johannes Kümmel¹, Dr. Olof Bäcke², Dr. Kristine Bakken²,
Dr. Magnus Hörnqvist Colliander², Prof. Mats Halvarsson²

¹Walter AG, Tübingen, Germany, ²Chalmers University of Technology, Göteborg, Sweden

dirk.stiens@walter-tools.com

Titanium aluminum nitride ($\text{Ti}_x\text{Al}_x\text{N}$) has found widespread application as a material for wear-resistant coatings on tools for metal cutting. By thermally activated chemical vapor deposition (CVD), $\text{Ti}_x\text{Al}_x\text{N}$ can be deposited with Al contents of up to $x \approx 0.9$, while retaining the face-centered cubic (fcc) structure. The first commercial products using CVD $\text{Ti}_x\text{Al}_x\text{N}$ coatings were introduced in 2011. The structural and mechanical properties of CVD $\text{Ti}_x\text{Al}_x\text{N}$ coatings have been the subject of numerous studies, focusing on the structure and origin of alternating nano-lamellae of different Al/Ti fractions, on mechanical properties and the thermal stability of the coatings. This presentation gives an overview of the structure and properties of state-of-art coatings. Advanced characterization techniques, as in-situ synchrotron diffraction and transmission electron microscopy (TEM) were used to study the evolution of microstructure and phase composition of coatings which were subjected to annealing. These structural changes can be related to the behavior of coated tools in metal cutting operations. We thereby show that understanding the wear behavior of CVD $\text{Ti}_x\text{Al}_x\text{N}$ coatings goes beyond analysis of structure and properties in the as-deposited state. Detailed, advanced studies of thermal stability and the use thermal treatments can provide useful approaches for further improvements of tool performance and an extension of the application range of CVD $\text{Ti}_x\text{Al}_x\text{N}$ coated tools in metal cutting.