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Composition, microstructure, and mechanical properties of boron containing multilayer coatings for hot forming tools

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Recently developed ternary Ti-B-N coatings for hot forming applications have a high potential for increasing the tool lifetime under the special requirements of mechanical and high temperature loading. They are thermally stable, in most cases antiadhesive against workpiece material at higher temperatures, and wear resistant.

The deposition of boron containing coatings was carried out by composing gradient layers through the variation of the boron and nitrogen content during PE-CVD processes. Additionally multilayered gradient coatings showed further optimization aspects. These findings can be used in different layer designs for further enhancements of the mechanical load capabilities of tool surfaces.

Recent studies address the investigation of the structural properties of different multilayer systems with altering elemental composition from pure TiB_2 to nitrogen containing boron composed regions. The coatings exhibit a nanostructured crystal morphology in means of a nanocomposite assembly where amorphous regions are containing nanocrystalline components. The micostructure and phase composition was investigated in detail with analytical methods for nanoscale dimensions like TEM, AES, EELS and nanoindentation.

A further issue for intense investigation refers to the correlation of the different layer designs with their mechanical properties in hot forming operations – especially in the field of precision forging processes. First approaches are showing good results in reducing adhesive wear even under thermal shock conditions.An overall stabilization of the planned tool life to enable a continuous production without needs of reworking the tools could be achieved. Finally, an increase in process reliability combined with a longer tool life was observed.