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Influence of Si Content on Mechanical and Tribological Properties of TiAlSiN PVD Coatings at elevated Temperatures

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TiN and CrN based binary or ternary coatings have been used for many years in order to extend the service life of machining tools. Increasing demands in metalworking industry requires more efficient coating systems. According to recent studies, silicon opened promising opportunities to influence the characteristics of thin titanium or chromium-based coatings for the better. Nanocomposite TiAlSiN presents high hardness and fine grain structure. Furthermore, by the addition of silicon, the oxidation resistance as well as the tribological properties can be increased and improved.
In order to adjust different coating compositions and thus modify its silicon content, various production parameters were systematically varied and their effects tested in detail. Within these studies, hot work tool steel AISI H11 was used as substrate. This steel substrate was previously plasma nitrided to increase hardness and hence carrying load of the system coating/substrate, avoiding shell egg effect during the analysis. The structure, morphology and different chemical compositions of the silicon-doped coating were investigated by means of scanning electron microscopy and energy dispersive X-ray spectroscopy. Scratch test is also performed in order to characterize the adhesion between the substrate and the coating. Since these coatings are exposed to high temperatures during machining processes, mechanical and tribological properties such as hardness, Young´s modulus, and friction and wear coefficient were determined at room temperature and 500°C. Additionally, thermal fatigue behavior, analyzed by means of an impact tester, was also evaluated at temperatures up to 500°C.

Keywords
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