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A study on the ternary elements (X= Co, Zr, Mo, Si, B) addition on the Ti-Al-N coating deposited by magnetron sputtering process with single alloying targets

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To improve the properties of TiAlN coating, third elements addition such as Co, Zr, Mo, Si, B has been popularly tried. The addition of Si to AlTiN and structurally well manipulation led to the formation of nano-composite coating of TiAlN and Si_3N_4 phases. This resulted in the super-hardness over 40 GPa and the increase of the oxidation temperature over 1000 °C. However, it is not easy to add Si to the AlTiN by a proper PVD system. So, Al-Ti-Si-N has been prepared by hybrid process with PVD with multiple target sources or PVD + PECVD with Si source gas.
In this study, Al-Ti based single alloying targets were prepared by powder metallurgy of mechanical alloying and spark plasma sintering. Also, Co, Zr, Mo, Si, B added targets were prepared to improve wear, thermal and oxidation properties. The investigation on the alloying targets showed that their microstructure was nano-sized about 20-30 nm and all the elements were homogeneously distributed.
Ternary Ti-Al-based coatings were deposited by unbalanced magnetron sputtering method with various alloying targets. The composition of the coating was almost same with that of the target. Their microstructures and mechanical properties were investigated by XRD, SEM, TEM, nano-indenter, tribometer, etc. The easiness of the nanocomposite structure was reviewed with alloying properties between alloying elements added in the coating. Also, the effects of the 3rd element on the wear and corrosion properties of the Ti-Al-N based coatings were reviewed in this study.

Keywords
Ti-Al-X-N ternary coatings
Single alloying target
Magnetron sputtering process
Nanocomposite coating
Third element addition (Co, Zr, Mo, Si, B)