Development of wear resistant hard film by RF sputtering method

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【Introduction】

Ceramic hard coating is used in industry as wear resistant coating for cutting tools. In the 1990s, TiAlN was developed by the PVD method, and these are still suppressing damage caused by tool wear. TiAlN show that increasing Al fractions in the range 60–70at% led to structural changes from the cubic NaCl to the hexagonal wurtzite structure [Fig.1]. And, the microhardness gradually increases with the incorporation of Al atoms into TiN, where the maximum hardness is obtained at an Al content corresponding to the phase boundary between the cubic and hexagonal structures.

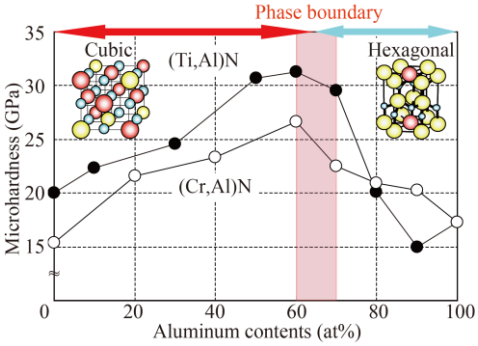

Fig.1 Microhardness with Al content of TiAlN and CrAlN.

CrAlN has been developed as an alternative to TiAlN hard coating and has good corrosion resistance and low friction properties, but low hardness [Fig.1]. Despite the increasing severity of the environment in which wear-resistant coatings are used, novel coatings have not been created.

【Purpose】

The purpose of this research is to fabricate a ceramic hard doatings with better mechanical properties than the commonly used TiAlN by the high frequency magnetron sputtering method. Then, the surface characteristics such as the microstructure and mechanical characteristics of the thin film are analyzed.

【Surface properties of CrAlSiN】

The CrAlSIN coating was synthesized by adding Si to CrAlN, showed 42 GPa higher than the hardness (30 GPa) of TiAlN, and reduced the wear depth after sliding test (Fig.2). Also, the oxidation resistance at 800-1200ºC improved with the increase of Si content. Furthermore, as a result of coating the tool with a cutting test, the effect of suppressing the initial flank wear of the tool was shown (Fig.3).

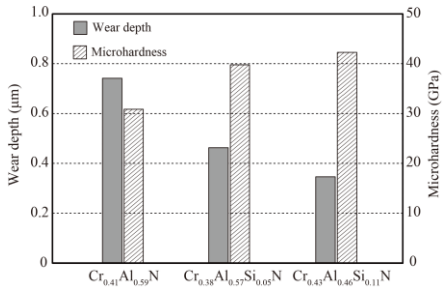

Fig.2. Microhardness and Wear depth

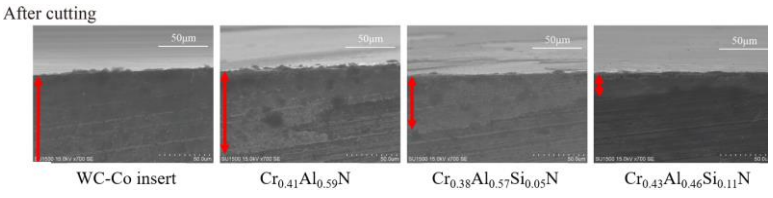

Fig.3. Observation of flank wear

【Challenges for the future】

- Improved adhesion
- Further improvement of wear resistance and heat resistance
- Realization of the processing of difficulty cut materials
- Expansion of applications ⇒ Machine component, Car component, Livingware, Medical equipment