Objective of the present invention

It is an objective of the present invention to provide a coating system for high performance cutting tools, in particular a broadband coating for high performance solid carbide drills which allows higher productivity compared to the state of the art, particularly in automotive applications such as steel and cast iron machining. Furthermore it is an objective of the present invention to provide an industrial-suited coating method for manufacturing the aforesaid high performance coated tools. Additionally the coating method according to the present invention should be as robust and uncomplicated as possible.

Summary

In one aspect, there is provided a coated body having a hard and wear resistant PVD coating, said coating comprising a nanolaminated structure (5) of alternating A- and B-nanolayers wherein the A-nanolayers have element composition $(Al_xTi_{1-x-y}W_y)N$, with $0.50 \leq x \leq 0.65$ and $0 \leq y \leq 0.10$, where the coefficients given by x, 1-x-y and y correspond to the atomic concentration of aluminum, titanium and tungsten, respectively, considering only the elements aluminum, titanium and tungsten for the element quantification in said A-nanolayers, and the B-nanolayers have composition $(Ti_{1-z-u}Si_zW_u)N$, with $0.05 \leq z \leq 0.30$ and $0 \leq u \leq 0.10$, where the coefficients given by 1-z-u, z and u correspond to the atomic concentration of titanium, silicon and tungsten, respectively, considering only the elements titanium, silicon and tungsten for the element quantification in said B-nanolayers, with an average individual thickness of the A- and B-nanolayers between 1 and 200 nm, respectively, **characterized in that** said nanolaminated structure of alternating A- and B-nanolayers exhibits a fine-grained structure, said fine-grained structure being

characterized by exhibiting in SEM micrographs of fractured cross sections of the coating a microstructure free of columns and by comprising grains whose largest size is 1/3 of the overall thickness of the nanolaminated structure.

In another aspect, there is provided a method for manufacturing a coated body having a coating comprising a nanolaminated structure of alternating A nano-layers consisting of at least 90 at.-% AlTiN and B nano-layers consisting of at least 90 at.-% TiSiN, wherein at least two arc vaporization sources are used for the deposition of the nanolaminated structure on the substrate surface to be coated, **characterized in that**

- each one of the at least two arc evaporation sources comprises a magnetic field arrangement provided on a target for generating magnetic fields on and above the target surface, wherein the magnetic field arrangement comprises marginal permanent magnets, a centric permanent magnet and at least one ring coil placed behind the target, whose inner diameter defined by the windings is smaller than or equal to, and in any case not considerably larger than the diameter of the target, and during the deposition of the nanolaminated structure the marginal permanent magnets are positioned away from the target, at a distance of several millimeters in relation to the target, in such a manner that the projection of the marginal permanent magnets onto the target surface is further away from the middle of the target surface by comparison to the projection of the ring coil onto the target surface, and the centric permanent magnet is positioned back away rear in relation to the target, and

- the target of one of the at least two arc evaporator sources comprises AlTi and the target of the another arc evaporator source comprises TiSi, and

- the distance between the permanent magnets and the target in each one of the at least two evaporation sources, are adjusted in such a manner that the nanolaminated film is deposited having a fine-grained microstructure which exhibits in SEM micrographs of fractured cross sections of the coating a microstructure free of columns.

In another aspect, there is provided a method for manufacturing a coated body having a coating comprising a nanolaminated structure of alternating A nano-layers consisting of at least 90 at.-% AlTiN and B nano-layers consisting of at least 90 at.-% TiSiN, wherein at least two arc vaporization source are used for the deposition of the nanolaminated structure on the substrate surface to be coated, **characterized in that**

- each one of the at least two arc evaporation sources comprises a target used as a cathode, an anode arranged in the direct neighborhood of the cathode, and magnetic means for producing a magnetic field, whose streamlines are led to the anode, wherein the arc evaporators are operated by setting coil currents and arc currents, and

- the coil current in each one of the at least two evaporation sources, are adjusted in such a manner that the nanolaminated film is deposited having a fine-grained microstructure which can be observed in SEM micrographs of fractured cross sections of the coating.

Description of the invention

The aforementioned objective is achieved by the present invention by providing a hard nano-layered coating system and a coating deposition method thereof both of them especially designed for improving efficiency of high performance cutting tools.

In order to better explain the present invention the figures 1 to 8 will be used for the description:

Figure 1: Draft of the coating architecture according to the present invention

Figure 2: Cutting Test 1

Figure 3: Cutting Test 2

Figure 4: Cutting Test 3

Figure 5: Fractured cross-section scanning electron micrographs of the inventive coating, a) Nanolaminated structure deposited at 570 °C, b) Nanolaminated structure deposited at 500 °C.