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[54] **CUTTING TOOL WITH ALLOY COATED SHARPENED EDGE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 47,664, June 19, 1970, abandoned, which is a continuation-in-part of Ser. No. 865,634, Oct. 13, 1969, abandoned, which is a continuation-in-part of Ser. No. 845,142, July 28, 1969, Pat. No. 3,682,795.

[52] **U.S. Cl.** **30/346.54**, 29/183.5, 30/165, 29/196, 29/198, 204/192, 75/176

[51] **Int. Cl.** **B26b 21/54**

[58] **Field of Search** 29/183.5, 196, 198; 204/192, 298; 30/346.53, 346.54, 165; 75/176

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[57] **ABSTRACT**

A protective layer of an alloy of platinum and chromium is formed on a substrate by sputtering, this metal alloy providing a hard, corrosion resistant, protective layer for the substrate.

28 Claims, 3 Drawing Figures

FIG. 1

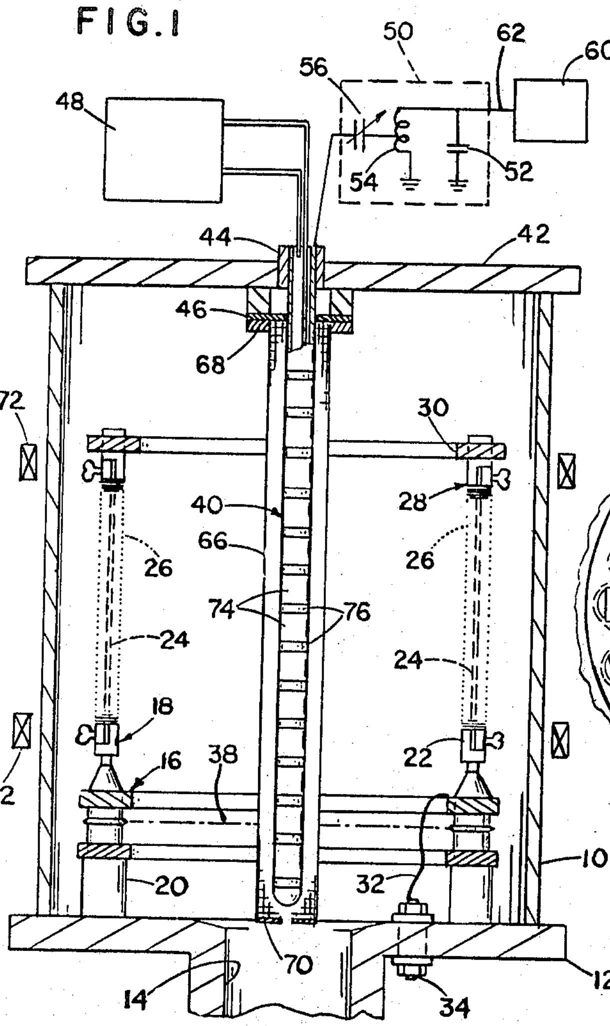


FIG. 2

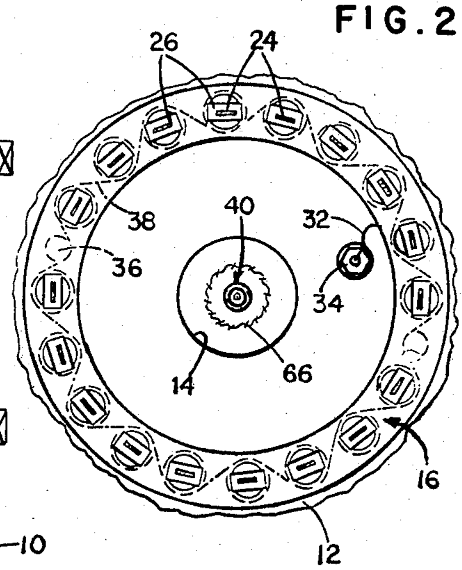
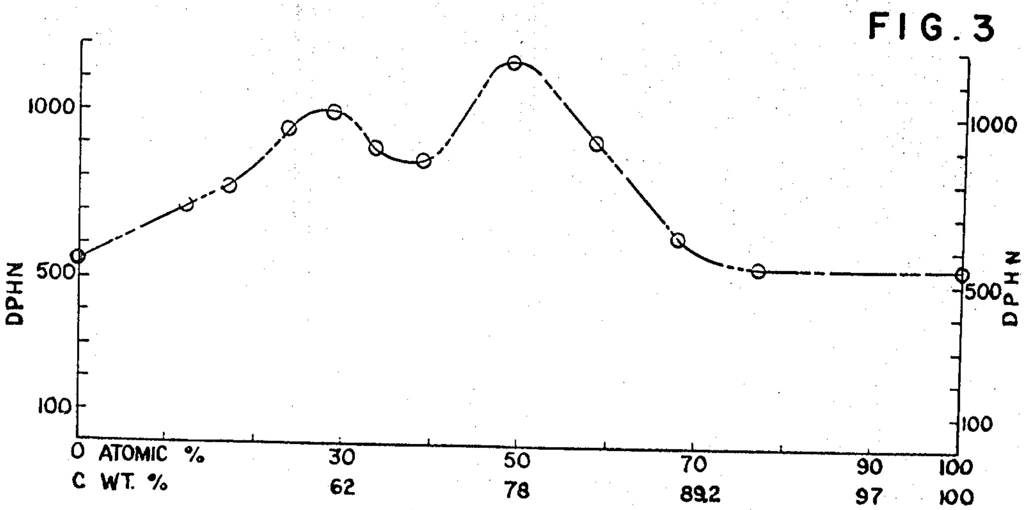


FIG. 3



CUTTING TOOL WITH ALLOY COATED SHARPENED EDGE

This application is a continuation-in-part of our copending patent application Ser. No. 47,664, filed June 19, 1970 and now abandoned and entitled "Razor Blades" which in turn was a continuation-in-part of prior patent application Ser. No. 865,634, filed Oct. 13, 1969 and now abandoned, which in turn was a continuation-in-part of prior application Ser. No. 845,142, filed July 28, 1969 now U.S. Pat. No. 3,682,795.

SUMMARY OF INVENTION

This invention relates to protective materials and to articles with protective metal layers which have excellent corrosion and wear resistant characteristics, and to improved methods and apparatus for manufacturing such articles.

Frequently the surface of an article requires protection against both mechanical wear and corrosion. Such surfaces include the interiors of piston chambers, for example in internal combustion engines; and surfaces of devices such as pumps or valves that are inserted into the human body. In the latter case, the device must operate reliably and without significant mechanical wear for years and not corrode or contaminate the system in which it is disposed.

Another such surface is the cutting edge of a razor blade which is sharpened with precision and is subjected both to corrosive atmospheres and to substantial mechanical force during shaving. The faces or sides of cutting edges of razor blades extend back from the ultimate edge and may comprise two or more "facets" formed by successive grinding or honing operations and intersecting each other along zones generally parallel to the ultimate edge. The final facet, that is the facet immediately adjacent the ultimate edge, may have a width of as little as **0.0003** inch or even less, while the thickness of the ultimate edge is generally less than 6,000A and preferably less than 2,500A. Due to its thinness, the ultimate edge is extremely susceptible to mechanical failure and, particularly in the case of carbon steel, to corrosion failure. It has been proposed to apply a coating of a corrosion resistant metal such as gold, rhodium or chromium to the sharpened edge of a razor blade by evaporation or sputtering. However, noble metals have not been satisfactory as they tend to break away from the underlying shaving edge under the abrasion forces encountered in shaving, such tendency rendering the blades commercially unsatisfactory. Further, a shave facilitating polymeric fluorocarbon coating is frequently cured on the blade edges by exposing the blades to elevated temperatures, e.g., 550° to 800° F. Such temperatures have a softening effect on the underlying blade metal, which softening adversely effects the shaving properties of the blades. In the case of razor blades, therefore, the metal film, in addition to having hardness and corrosion resistance characteristics, should maintain significant hardness at fluorocarbon sintering temperatures even though the underlying steel softens, should have adhesion compatibility with both the underlying steel and the overlying polymeric coating so that all the layers remain firmly adhered to one another throughout the shaving life of the blade and should not otherwise have an adverse effect on shaving characteristics.

It is a general object of this invention to provide novel and improved articles which have improved mechanical properties and especially improved corrosion and wear resistance and novel and improved methods and apparatus for producing such articles.

A more specific object of the present invention is to provide a substrate with a hard protective metal film having improved corrosion resisting properties which is firmly adherent to a substrate surface and provides a sturdy base for polymeric coatings which are formed at elevated temperatures.

A further object of the invention is to provide novel and improved methods for providing an article having superior wear and corrosion resistant properties.

Another object of the invention is to provide novel and improved methods and apparatus for improving the wear and corrosion resisting properties of a substrate in a mass production process and in a manner that does not impair the quality of the underlying substrate.

A still further object of the invention is to provide a novel and improved razor blade which possesses superior shaving properties.

Another object of the present invention is to provide a metal film on a razor blade which has improved corrosion resisting properties, which is firmly adherent to the surfaces of the blade edge and which provides a sturdy and compatible base for polymeric coatings which are formed at elevated temperatures.

In accordance with the invention there is provided a substrate with a firmly adherent film of alloy of a first metal selected from the class consisting of iridium, osmium, platinum, palladium, rhenium, rhodium and ruthenium (hereinafter termed an N metal) and a second metal selected from the class consisting of chromium, manganese, niobium, molybdenum, tantalum, titanium, tungsten, vanadium and an N metal different from the other metal of the alloy, (hereinafter termed a strengthening metal); the class consisting of chromium, molybdenum, niobium, titanium, vanadium and an N metal being a preferred class. Particularly advantageous are those alloy compositions that form an intermetallic compound with either the ordered A15 cubic structure or the tetragonal ordered (sigma phase) structure and alloy compositions within about ±5 weight percent of these compounds, those alloys having excellent heat stability.

In the case of platinum-chromium alloys, a preferred range of platinum content is 15–65 atomic percent and where the environment of use is particularly corrosive it is preferred that the platinum content be at least 21 atomic percent.

The alloy of the invention has a micro hardness greater than 750 DPHN and an extremely fine grained structure, the crystallite size, as determined by electron microscopy or electron diffraction techniques, being less than one thousand Angstroms. For example, the crystallite size of thin film platinum-chromium alloys in accordance with the invention in as sputtered condition is less than fifty Angstroms. Substrates having alloy films on them in accordance with the invention exhibited no sign of corrosion after immersion in concentrated hydrochloric acid for one minute. A platinum-chromium alloy in accordance with the invention having a platinum content of 21 atomic percent has a dissolution rate in boiling hydrochloric acid of 0.008 mils per minute, which may be contrasted with a dissolution rate of 1,000 mils per minute for pure chromium in boiling hydrochloric acid. In typical applications, the alloy film in accordance with the invention is at least fifty Angstroms in thickness, is continuous, and is of uniform thickness.

Where the substrate is the sharpened edge of a steel razor blade, the M_3N compound is particularly advantageous as it has greater heat stability than the underlying steel. For example, the hardness of a Cr_3Pt alloy film on a razor blade in accordance with the invention is substantially independent of heat treatment temperatures up to 1,200° C. In such a platinumchromium alloy film, a preferred range of platinum content of the film is 15–30 atomic percent and particularly advantageous results are obtained with a film having a platinum content of 21–27 atomic percent. The alloy film in accordance with the invention is at least as hard as the underlying blade metal and should not exceed 600A in thickness, a preferably range being 50–500A and the best results being obtained with a thickness in the range of 100–400A. Further, where a fluorocarbon shave facilitating coating is utilized, alloy films that employ either chromium or an N class metal as the strengthening metal provide most satisfactory coating adherence. In cases where the adhesion of the fluorocarbon coating to the alloy appears to be inadequate, (i.e., W-Pt) the benefits of the hard alloy coating can be obtained by the use of a very thin (about 75A or less) overlayer of the Cr_3Pt alloy as an interfacial bonding agent.

In the manufacture of razor blades, the alloy film should be applied with processes and apparatus that permits production of large quantities of razor blades with a minimum of additional processing steps, and accordingly, a further object of the invention is to provide novel and improved methods and apparatus for placing a metal alloy film having superior corrosion resistant properties on the sharpened edges of razor blades with controlled uniformity.

Another object of the invention is to provide novel and improved apparatus for placing a film of improved corrosion resistant alloy on the sharpened edges of razor blades in a mass production process and in a manner that does not impair the quality of the sharpened edges.

Still another object of the invention is to provide a novel and improved commercial production blade treatment system in which the sharpened edges of razor blades are cleaned and a thin film of a corrosion resistant metal alloy that is at least as hard as the underlying blade metal is applied to the cleaned sharpened blade edges.

A blade treatment system in accordance with this feature of the invention includes an evacuable chamber in which is disposed structure for receiving one or more stacks of razor blades, the blades in each stack being disposed in face to face relationship with their sharpened edges in alignment. Also disposed within the chamber is a source of metal that extends along a line parallel to the exposure axis (or plane) of each razor blade stack. The source includes an N metal and a strengthening metal in metallurigically separate form from the N metal. The source may take various forms, for example it may be a sintered compact of the metals of which the alloy is to be formed, or an assembly of one or more segments of the strengthening metal component of the alloy to which appropriately spaced segments of the N metal component of the alloy are secured. In processing the blades, after the blade edges are cleaned in the vacuum chamber, the metal source is energized in a reduced pressure gaseous environment to transfer the metals from the source and form on the blade edges a thin film alloy of the metals of the source. A preferred method of forming the alloy film on the blade edges is to subject the composite metal source to an ion bombardment process ("sputtering") to transfer metal atoms to the sharpened blade edges. Other deposition techniques, such as evaporation utilizing an electron gun source or induction heating may also be used where appropriate. Where a fluorocarbon polymer is subsequently sintered on the alloy film, an inert gas such as argon or nitrogen is preferably employed as the sintering atmosphere, although other sintering atmospheres, such as cracked ammonia or hydrogen may be utilized, particularly with alloys with relatively small amounts of the N metal.

This invention is particularly useful in providing an improved thin protective metal alloy film on the sharpened edges of razor blades, which thin film does not have an adverse effect on shaving characteristics of the blade and which does not require further mechanical working of the blade edge area to provide satisfactory first shave quality. A wide range of blade materials may be used, specific razor blade steel compositions with which the invention may be practiced including the following:

COMPOSITION IN %

C	Cr	Mo	Si	Ni
1.25	.2	—	.2	—
1.00	6.0	—	1.4	—
.96	13.9	—	.3	—
.65	10.5	1.0	.3	—
.58	14.0	—	.3	—
.40	13.5	1.25	.3	—
.09	17.0	.70	1.2	8.0

The preferred metal alloy coatings on the edges of the blades of the invention are significantly harder than the blade bodies (having micro hardnesses of up to about 1,700 DPHN), remain harder than prior art commercial blades after the blades are subjected to polymer curing temperatures in the range of 550°–800° F, and have excellent corrosion resistance.

Other objects, features and advantages of the invention will be seen as the following description of particular embodiments of the invention progresses, in conjunction with the drawings, in which:

FIG. 1 is a sectional view of a form of apparatus employed in the practice of the invention;

FIG. 2 is a sectional view of the apparatus shown in FIG. 1, taken along the line 2—2 of FIG. 1; and

FIG. 3 is a graph indicating characteristics of an alloy in accordance with the invention.

DESCRIPTION OF PARTICULAR EMBODIMENTS

The sputtering (ion bombardment) apparatus shown in FIG. 1 includes a stainless steel cylinder chamber **10** 18 inches in diameter and 32 inches high mounted on base **12**. Base **12** is coupled through port **14** to a suitable vacuum system (not shown). A butterfly valve that has an aperture one inch in diameter is disposed downstream of port **14** and may be moved to closed position during sputtering to reduce back streaming of the diffusion pump. Mounted in chamber **10** on ring assembly **16** for rotation about vertical axes are eighteen blade stack support structures **18**. Assembly **16** is isolated electrically from base **12** by six post structures **20**. Each blade stack support structure **18** includes a base structure **22** that has a recess for receiving the lower end of a relatively rigid elongated blade aligning leaf or knife **24** on which a stack of razor blades **26** is positioned. A clamping structure **28** at the upper end of knife **24** secured a stack of blades **26** in position on the knife and in turn is secured to an upper aligning ring **30**. An electrical connection to the blade stacks **26** is made via conductor **32** and feed through connection **34** in the base **12**. Drive shaft **36** is coupled to ring assembly **16** to rotate the blade stacks **26** via chain **38**. In a typical processing run of double edged blades in this apparatus, each stack is twelve inches long and contains three thousand blades while in a typical processing run of single edge injector blades, each stack contains twelve hundred blades. The sharpened edges of the blades are 6¾ inches from the axis of chamber **10**. Other support structures, such as those for coils of blade strip of the type disclosed in co-pending application Ser. No. 693,529, filed Dec. 26, 1967 and now abandoned, may be substituted for these support structures.

Also mounted within the chamber coaxially with the chamber axis is a target rod **40** that in a particular embodiment includes platinum and chromium. Rod **40** is suspended from chamber top plate **42** by insulator structure **44**. A water cooled dark space shield **46**, also suspended from top plate **42**, is provided to protect insulator **44**. The exposed length of target rod **40** below shield **46** is 29 inches and that exposed length is positioned symmetrically with respect to the stacks of razor blades **26**. In these embodiments the rod **40** is 1¼ inches in diameter and has a wall thickness of one-fourth inch. Coolant from a suitable source **48** is circulated through rod **40** for cooling purposes. Connected to the target rod **40** is a matching network **50** that includes fixed capacitor **52**, inductor **54** (adjustable over the range 0–5 microhenrys) and capacitor **56** (adjustable over the range 0–1,000 picofarads), the matching network being connected to an RF (13.56 mHz) voltage supply **60** via shielded conductor **62**.

A stainless steel wire mesh cylinder **66**, 3¼ inch in diameter with one-eighth inch apertures, is suspended from dark space shield **46** by flange **68** that is solidly bolted to shield **46**. A stainless steel plate **70** is secured at the lower end of mesh cylinder **66**. Two Helmholtz coils diagrammatically indicated at **72** surround chamber **10**, one above and one below the blade stacks. These coils, when energized, create a vertical magnetic field of about 100 gauss magnitude in the chamber **10**. The use of mesh cylinder **66** and the magnetic field increases the metal deposition rate and reduces secondary electron bombardment of the blades.

The target **40** may take a variety of forms. In one form the target may be a sintered compact of platinum and chromium. In a second form as indicated in FIG. **1**, the target **40** is formed of alternating exposed sections of chromium **74**, and platinum **76**. In one embodiment, strips of platinum ribbon, each strip being 0.002 inch thick, ½ inch wide and 4 inches long, are disposed in annular grooves in a chromium rod to form rings **76** which are spot welded to the rod. The rings **76** are equally spaced from one another and in the illustrated embodiment, the exposed surface area of this target assembly is 19 percent platinum and 81 percent chromium.

In operation of this apparatus, the sharpened blades **26** in stacks, are placed in the chamber on knives **24**. The chamber is evacuated and argon at a pressure in the range of **10** microns is placed in the chamber. The blades are then energized with a DC potential applied through connection **34** (the chamber being grounded) and cleaned by glow discharge for 5 minutes. After cleaning, the chamber is evacuated and argon at pressure of 5–8 microns is placed in the chamber. With the blade stacks and chamber grounded, a potential is applied from power supply **60** to target **40**. Argon ions are produced which bombard target **40** and release atoms of the two metals. The released atoms are deposited on exposed surfaces, including the sharpened blade edges. This operation with an elongated target rod and plural blade stacks forms an easily controlled platinum-chromium alloy coating uniformly on the blade edges to thicknesses of less than 600A. The alloy composition is a direct function of the exposed surfaces of the metals in the target rod. Thus, with the specific target rod configuration shown in FIG. **1** an alloy composition close to the platinum-chromium compound Cr_3Pt is deposited, the alloy having about 55 weight percent (24 atomic percent) platinum. Deposition rates are a function of applied power. For example, an input power of two kilowatts provides a deposition rate of 50A/ minute while an input power of five kilowatts provides a deposition rate of 150A/ minute.

The graph of FIG. **3** shows micro hardness (using a Vickers diamond needle with a two hundred gram load and converted to DPHN) of platinum-chromium alloys of differing compositions deposited by sputtering on a planar substrate to a thickness of 0.0015 inch in accordance with the invention, the graph being a plot of hardness as a function of the platinum content of the sputtered alloy. The hardness of the alloys in the vicinity of the intermetallic compound Cr_3Pt (25 atomic percent platinum), which compound has the A15 cubic crystalline structure, remains stable and is substantially independent of heat treatment up to 1,200° C. The 50 atomic percent chromium-platinum alloy is disordered as sputtered in a thin film but undergoes ordering on heating with a significant increase in strength, the hardness peak at about 50 atomic percent platinum being due to the heating to which the material was subjected during the sputtering of the layer to a thickness of 0.0015 inch.

As a specific example, sixty thousand stainless steel razor blades having the following composition:

carbon	.54 – .62%
chromium	13.5 – 14.5%
manganese	.20 – .50%
silicon	.20 – .50%
phosphorus, max.	.025%
sulphur, max.	.020%
nickel, max.	.50% max.
iron	remainder

were sharpened to an included solid angle of 24.8° and placed on 18 knives **24**.

The pressure in the chamber was reduced to 0.1 micron and a discharge sustaining atmosphere of argon was then bled into the chamber to increase the pressure to 10 microns. A direct current glow discharge was initiated in this argon atmosphere at a voltage of 1,600 volts and a current of 1,100 milliamperes and maintained for 5 minutes. The blade stacks **24** were then connected to ground and 4 kilowatts of RF power (at a frequency of 13.56 megacycles and at a DC negative bias of about 900 volts with a superimposed RF signal of about 1,000 volts peak to peak) was applied to rod **40** with the matching network adjusted for zero reflected power for 4 minutes. The RF power was applied 10 seconds before application of the DC power was entirely terminated and was increased gradually to 4 kilowatts as the DC power was being reduced. The Helmholtz coils **72** were energized at the same time that the RF power was initially applied. After the end of the four minute sputtering interval the blade stacks were turned and the above described cleaning and sputtering steps were repeated. The resulting platinum-chromium alloy coating had a hardness of about 960 DPHN and a thickness of about 350A and extended along the entire cutting edge of the blades and back along the final facet for a length of at least 0.001 inch. A coating of polytetrafluoroethylene telomer was then applied to the edges of the blades in accordance with the teaching in copending application Ser. No. 384,805, filed July 23, 1964 in the name of Irwin W. Fischbein now U.S. Pat. No. 3,518,110. This processing involved heating the blades in an argon environment to a temperature preferably in the range of 590°–806° F and provided on the cutting edges of the razor blades an adherent coating of solid fluorocarbon polymer. After heating the equivalent hardness of the edge metal (the composite of the thin alloy film and the underlying blade metal) was 700 DPHN. These blades exhibited excellent shaving properties and long shaving life.

As a second example, a pure chromium disc 6 inches in diameter and one-fourth inch thick had spot welded to its surface squares of pure platinum foil 1 cm. on a side and 0.002 inch thick. These foil squares were spaced on the surface so that 27 percent of the chromium surface was covered with platinum. A 4½ inch stack of stainless steel blades were placed on a 5 inch diameter aluminum disc in an RF sputtering unit. (This apparatus may also be used for processing a coiled stack of blade strip with the strip placed on the aluminum disc so that the sharpened edges of the strip are aligned with one another and define an exposure axis or plane.) The platinum-chromium disc surface was disposed parallel to the blade edges at a distance of 2½ inches. The RF power could be fed to the plate supporting the blades or to the platinum-chromium plate above the blade stack. The pressure in the vacuum chamber was reduced to 0.1 micron of mercury and then pure argon gas was bled into the chamber to a pressure of ten microns of mercury. The aluminum disc and blades were then cleaned for 2 minutes with 0.2 KW of RF power (at 13.56 megacycles with a DC negative bias of about 2,500 volts and a superimposed RF signal of about 3,300 volts peak to peak). The platinum-chromium target was covered by a metal shield during this cleaning step. The shield was then placed so that the blades were shielded and the platinum-chromium target plate was cleaned with an applied power of 0.4 KW (at 13.56 megacycles with a DC negative bias of about 3,400 volts and a superimposed RF signal of about 4,500 volts peak to peak), for 1 minute, while maintaining 10 microns of mercury pressure of argon gas. The shield was then removed from between the blades and the platinum-chromium target. Sputtering (ion bombardment) of the target now proceeded at 0.4 kilowatts for 1 minute and 40 seconds. The edges of the blades facing the target received a platinum-chromium alloy coating consisting of 58 weight percent platinum and 42 weight percent chromium to a thickness of about 250A and a hardness of about 800 DPHN. These blades, when coated with a thin film of a PTFE telomer in the same manner as in the previous example exhibited excellent shaving properties.

As a third example, a titanium disc one-eighth inch thick and 3 inches in diameter (appropriate dark space shielding producing an effective disc diameter of 2⅝ inches) had spot welded to its surface squares of pure platinum foil one-half cm. on a side and 0.010 inch thick. These foil squares were placed on the surface of the disc so that 8 percent of the titanium surface was covered with platinum. A stack of one hundred stainless steel blades was placed on a water cooled five inch diameter aluminum disc in an RF sputtering unit. The platinum-titanium disc surface was disposed parallel to the blade edges at a distance of 2½ inches. A shutter was interposed midway between the blades and the platinum-titanium disc. An environment of argon gas at a pressure of 10 microns of mercury was placed in the vacuum chamber. The aluminum disc and blades were than cleaned for 2 minutes at 0.2 kilowatts of RF power at 13.56 mHz (with a DC negative bias of about 2,500 volts and a superimposed RF signal of about 3,300 volts peak to peak), during which interval the platinum-titanium target was shielded by the shutter. The target was then presputtered with an applied power of 0.8 kilowatts (at 13.56 megacycles with a DC negative bias of about 4,200 volts and a superimposed RF signal of about 5,000 volts peak to peak) for ten minutes while maintaining the pressure of the argon gas in the chamber at 10 microns of mercury. The shutter was then removed from between the blades and platinum-titanium target and a platinum-titanium alloy was deposited on the blade edges by sputtering at 0.8 kilowatts applied power for 2 minutes. The coating was a platinum-titanium alloy consisting of 24 atomic percent platinum and seventy-six atomic percent titanium and had a thickness of about 350A and was harder than the underlying blade metal. These blades, when coated with a suitable interfacial bonding layer and a thin film of PTFE telomer exhibited excellent shaving properties and long shaving life.

As a fourth example, employing a similar group of blades six tungsten coils plated with palladium were mounted in a chamber of the type disclosed in copending application Ser. No. 693,529, filed Dec. 26, 1967 and now abandoned. With argon in the chamber at a pressure of 10 microns, a glow discharge was initiated at a voltage of 1,600 volts and a current flow of 975 milliamperes for 7 minutes. The argon flow was then terminated and the pressure in the chamber reduced to 0.1 micron. The tungsten-palladium coils were then energized with an electrical potential of 12 volts and an electric current of 200 amperes for 15 minutes to vaporize both palladium and tungsten and deposit on the blades a palladium-tungsten alloy that contained about 50 percent palladium and 50 percent tungsten by weight. The coated edges had an equivalent hardness of 690 DPHN and after application of the fluorocarbon telomer as in the other examples the equivalent hardness of the edge metal was 650 DPHN. The blades exhibited excellent shaving properties.

In a fifth example, a brass target 6 inches in diameter was osmium plated. Chromium was then sputtered onto the target through a mask so that 10 square inches of osmium appropriately spaced to provide uniform deposition of osmium was left exposed. This osmium-chromium target was used in the same apparatus as used in the second example. The aluminum disc and blades were cleaned for 2 minutes with an RF power of 0.2 kilowatts; the osmium-chromium target was then presputtered for 1 minute at an applied RF power of 0.4 kilowatts; and then sputter deposition proceeded for 2 minutes at an RF power of 0.4 kilowatts. The edges of the blades facing the target received an osmium-chromium alloy coating consisting of 32 atomic percent osmium and 68 atomic percent chromium to a thickness of 250 Angstroms. The blades were then coated with a thin film of PTFE telomer and exhibited excellent shaving properties.

Other examples of the invention utilizing the same equipment as in the second example are summarized in the following table:

ALLOY	TARGET COMPOSITION	PROCESSING Cleaning	 Presputtering	 Sputtering	FILM Thickness (A)	 Composition	 Hardness
Iridium Chromium	71.7% Chromium 28.3% Iridium	RF 0.2 Kw 2 mins.	RF 7 mins. 0.4 Kw	RF 75 secs. 0.4 Kw	250	69% Chromium 31% Iridium	1700
Platinum Tungsten*	91% Tungsten 9% Platinum	RF 0.2 kw 2 mins.	RF 3 mins. 0.4 kw	RF 100 secs. 0.4 Kw	250	84% Tungsten 16% Platinum	
Iridium Platinum	79% Iridium 21% Platinum	RF 0.2 Kw 2 mins.	RF 5 mins. 0.4 Kw	RF 75 secs. 0.4 Kw	320	75% Iridium 25% Platinum	1300
Iridium Vanadium*	84.8% Vanadium 15.2% Iridium	DC 2000 volts 25 ma 7 mins.	RF 6 mins. 0.4 Kw	RF 120 secs. 0.4 Kw	200	V_3Ir	1300
Iridium Tantalum*	86% Tantalum 14% Iridium	RF 0.2 Kw 2 mins.	RF 8 mins. 0.4 Kw	RF 120 secs. 0.4 Kw	240	Ta_3Ir	1450
Ruthenium Chromium	71% Chromium 29% Ruthenium	DC 2000 volts 25 ma 7 mins.	RF 5 mins. 0.4 Kw	RF 100 secs. 0.4 Kw	250	71% Chromium 29% Ruthenium	1200

The alloys indicated by an asterisk exhibited inferior adhesion compatibility with the PTFE telomer. Satisfactory adhesion was achieved by depositing an interfacial layer of Cr_3Pt on those alloys. After sputter deposition of the alloy, a chromium disc with platinum squares spot welded to it was substituted for the target in the deposition chamber. The blades with the alloy film were cleaned for 30 seconds at 0.2 KW RF power; the substituted target was presputtered for 10 seconds at 0.4 KW RF power; and then the Cr_3Pt alloy was sputter deposited for thirty seconds at 0.4 KW RF power, forming a 75A interfacial bonding layer for the PTFE telomer, the blades so treated exhibited excellent shaving properties and long shaving life.

While particular embodiments of the invention have been shown and described, various modifications thereof will be apparent to those skilled in the art and therefore it is not intended that the invention be limited to the disclosed embodiment or to details thereof and departures may be made therefrom within the spirit and scope of the invention.

What is claimed is:

1. A cutting tool comprising a substrate having a sharpened edge and an alloy film of composition different from said substrate on said sharpened edge, said alloy film having a microhardness of at least about 750 DPHN and being an intermetallic compound with either the ordered A15 cubic structure or the tetragonal ordered structure or a composition with proportions within about ±5 weight percent of such a compound, said alloy film consisting of a first metal selected from the class consisting of iridium, osmium, palladium, platinum, rhenium, rhodium, and ruthenium and a second metal selected from the class consisting of chromium, manganese, molybdenum, niobium, tantalum, titanium, tungsten, and vanadium.

2. An article according to claim 1 in which said first metal is selected from the class consisting of iridium, osmium, platinum, rhenium, rhodium, and ruthenium and said second metal is chromium.

3. An article according to claim 1 wherein said second metal is selected from the class consisting of chromium, molybdenum, niobium, titanium, and vanadium.

4. An article according to claim 1 in which said first metal is selected from the class consisting of platinum, iridium, and osmium.

5. An article according to claim 1 in which the alloy film is at least as hard as said substrate.

6. An article according to claim 1 wherein the alloy film on said substrate has a maximum crystallite size of less than 1,000A.

7. The article as claimed in claim 6 wherein said second metal is chromium.

8. An article according to claim 1 in which the alloy film is composed of platinum and chromium.

9. An article according to claim 8 in which the alloy film is composed of 21–27 atomic per cent platinum and the remainder chromium.

10. An article according to claim 1 in which the alloy film is composed of platinum and titanium.

11. The article as claimed in claim 1 wherein said alloy film has a thickness of at least 50A.

12. The article as claimed in claim 1 wherein the thickness of said alloy film is in the range of 100–400A.

13. The article as claimed in claim 1 wherein said substrate is steel.

14. A razor blade comprising a substrate having a sharpened edge and an alloy film of composition differ-

ent from said substrate on said sharpened edge, said alloy film having a microhardness of at least about 750 DPHN and being at least as hard as the underlying substrate material and being an intermetallic compound with either the ordered A15 cubic structure or the tetragonal ordered structure or a composition with proportions within about ±5 weight percent of such a compound, the intermetallic compound consisting of a first metal selected from the class consisting of iridium, osmium, palladium, platinum, rhenium, rhodium, and ruthenium and a second metal selected from the class consisting of chromium, manganese, molybdenum, niobium, tantalum, titanium, tungsten and vanadium.

15. The blade as claimed in claim **14** wherein said second metal is selected from the class consisting of chromium, molybdenum, niobium, titanium, and vanadium.

16. The blade as claimed in claim **14** wherein said first metal is selected from the class consisting of iridium, osmium, platinum, rhodium and ruthenium, and said second metal is selected from the class consisting of chromium and titanium.

17. The blade as claimed in claim **14** wherein said first metal is selected from the class consisting of iridium, osmium and platinum and said second metal is chromium.

18. The blade as claimed in claim **14** wherein said alloy film is composed of 20–30 atomic per cent platinum and the remainder chromium.

19. The blade as claimed in claim **14** wherein said alloy film is composed of 21–27 atomic per cent platinum and the remainder chromium.

20. The blade as claimed in claim **14** wherein said alloy film has a thickness of less than 600A.

21. The blade as claimed in claim **14** wherein the thickness of said alloy film is in the range of 100–400A.

22. The blade as claimed in claim **21** wherein the corrosion resistance of said alloy film is such that the cutting edge of said blade shows no sign of corrosion after immersion in concentrated hydrochloric acid for one minute.

23. The blade as claimed in claim **22** wherein said second metal is chromium.

24. The blade as claimed in claim **23** wherein said alloy film is composed of 20–30 atomic per cent platinum and the remainder chromium.

25. The blade as claimed in claim **24** wherein said alloy film is composed of 21–27 atomic per cent platinum and the remainder chromium.

26. The blade as claimed in claim **14** and further including a thin chromium containing overlayer on said alloy film, said overlayer being of a different composition from said alloy film.

27. The blade as claimed in claim **22** wherein said first metal is selected from the class consisting of iridium, osmium and platinum and said second metal is chromium.

28. The blade as claimed in claim **27** wherein said alloy film is composed of 21–27 atomic per cent platinum and the remainder chromium.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,829,969 Dated August 20, 1974

Inventor(s) Irwin W. Fischbein et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Item [63] after "June 19, 1970", change "abandoned" to --Pat. No. 3,725,238--.

Column 1, lines 6-7, change "abandoned and entitled "Razor Blades"" to --U.S. Pat. No. 3,725,238--.

Signed and sealed this 7th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents