# United States Patent [19]

**Sanderson**

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[54] **RAZOR BLADES AND METHODS OF MANUFACTURE THEREOF**


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[52] **U.S. Cl.** .................. **117/75,** 117/69, 117/71 M, 30/346.53, 204/192, 29/195, 29/191

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

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[57] **ABSTRACT**


On a razor blade having at least one cutting edge there are provided two different superposed coatings, each coating being of a metal, a metallic compound, a silicon compound or an alloy of any of the foregoing. Preferably the upper coating is itself coated with a polymer which improves the shaving properties of the blade, for example polytetrafluoroethylene.


**21 Claims, No Drawings**

# RAZOR BLADES AND METHODS OF MANUFACTURE THEREOF

This invention relates to razor blades and to methods of manufacture thereof.

It is known to provide a coating of chromium on the cutting edge of a razor blade and to coat the chromium with polytetrafluoroethylene.

According to the present invention there is provided a razor blade having two different superposed coatings each coating being of a metal, a metallic compound, a silicon compound or an alloy of any of the foregoing.

Preferably the lower coating is a metal one and the upper coating is a refractory metallic compound. The surface region of the lower coating may be oxidised.

The invention also provides the method of manufacturing a razor blade wherein at least a cutting edge is coated with a metal, metallic compound or an alloy containing a metal or metallic compound, and the initial coating is thereafter provided with a coating of a different metal, metallic compound or alloy containing a metal or metallic compound or with a silicon compound.

The reasons why the present invention results in an improvement is not fully understood at the present time. However, without limitation of the scope of the invention, the applicants believe that as a general guide to the materials which may be used for the non-polymer coatings, it is preferable to use for the initial coating a material which will function to strengthen the cutting edge and reduce damage which occurs to the cutting edge during shaving as well as functioning to reduce corrosion. Examples of materials which may be used for this initial coating are chromium, platinum and other noble metals including iridium, osmium, palladium, rhodium and ruthenium, titanium, zirconium, vanadium, niobium, tantalum, molybdenum, cobalt, nickel, manganese, rhenium and tungsten, as well as alloys of any of the foregoing.

On the same basis as above it is believed that the second coating is preferably chosen for its wear resistant and corrosion protection properties so that it presents a surface which is less susceptible to progressive wear during shaving than is the initial coating. Alternatively or additionally the second coating may be chosen to provide a better substrate for the adhesion of the subsequently applied polymer coating and/or to facilitate crystallisation of the polymer coating upon deposition in a manner which results in an improved polymer coating. Examples of materials which may be used for the second coating are carbides, borides, oxides, nitrides, silicides and fluorides (all being examples of typical so-called "refractory" materials) either alone or mixed (e.g., carbonitrides) of the following elements where appropriate: chromium, silicon, tungsten, molybdenum, cobalt, aluminium, manganese, vanadium, niobium, tantalum, titanium, zirconium, hafnium, rhenium and the rare earths.

The specific combination of a lower coating of chromium and an upper coating of chromium nitride is the subject of a co-pending application, Ser. No. 140,186 filed on the same day as the present application.

Preferably, the second coating is then provided with a coating of a polymer which improves the shaving properties of the blade and may, for example, comprise a fluorocarbon polymer, for example polytetrafluoroethylene, or a copolymer of thio-carbonyl fluoride and tetrafluoroethylene.



Thus, in a typical form of the invention the blade is first provided with a chromium coating on the cutting edge, thereafter a molybdenum nitride coating is superposed on the first coating and, finally, a polymer coating is provided on the nitride coating. Another typical second coating would be vanadium nitride.

One method of providing a stainless steel razor blade with a double coating of the form just described is, first, to form a chromium coating by sputtering chromium onto the previously cleaned cutting edges from electroplated targets at a pressure of between 1/10 of a micron and 10 microns of mercury in a residual atmosphere of inert gas such as argon or helium using commercially available ion-plasma sputtering apparatus. The chromium coating may, for example, be of a thickness between 50 and 450 Angstroms but preferably not greater than 200 Angstroms. Thereafter the sputtering process is repeated using molybdenum plated targets with a residual atmosphere of nitrogen at a pressure of, for example, 1 to $4 \times 10^{-3}$ millimetres of mercury, to form a molybdenum nitride coating.

Preferably, the blades are exposed to an oxide-forming atmosphere after formation of the initial coating so that the surface region of the initial coating is oxidised. One way of achieving this is by allowing a controlled air leak into the sputtering apparatus between the two coating stages.

The second coating may have a thickness of, for example, from 50 to 450 Angstroms but preferably not greater than 150 Angstroms and a preferred range for the thickness of the two coatings together is from 100 to 500 Angstroms or even up to 750 Angstroms.

The reaction between molybdenum, or whatever other metal is used, and nitrogen or other gas in the sputtering process may take place on the surface of the target, or as the metallic particles are being sputtered through the ionised plasma or after the metal has been deposited on the blade surface.

The gas composition can vary widey depending upon the material being sputtered and the sputtering conditions. Thus, for example, the nitrogen or other gas may be diluted with an inert gas, such as argon, from 5 volume percent of the gas in argon to 100 volume percent of the nitrogen or other gas. For nitride formation one may use, for example, a gas with a large nitrogen content such as cracked ammonia and/or air diluted by an inert gas.

The sputtering may be direct current or radio frequency sputtering and in the latter case sputtering may be direct from a nitride or other metallic compound target in an inert atmosphere.

As an alternative to sputtering the coatings may be produced by chemical vapour deposition or by reactive evaporation.

It will be understood that the terms "metallic compound" and "silicon compound" as used herein embrace not only compounds of a metal or silicon but also a distribution or dispersion of such compounds in a metallic matrix.

I claim:

**1.** A razor blade for shaving having at least one cutting edge, a first coating on said cutting edge comprising a material selected from the group consisting of metals, alloys, metal compounds and silicon compounds to strengthen said cutting edge, reduce corrosion thereof and reduce damage to said cutting edge during shaving and a second coating different from said first coating and superposed thereon, said second coating comprising a material selected from the group consisting of metals, alloys, metal compounds and silicon compounds to improve the wear resistant and corrosion protection properties to present a surface less susceptible to progressive wear during shaving than said first coating.

**2.** A razor blade according to claim **1**, wherein the surface region of the lower coating is oxidised.

**3.** A razor blade for shaving having at least one cutting edge, a first coating on said cutting edge comprising an alloy to strengthen said cutting edge, reduce corrosion thereof and reduce damage to said cutting edge during shaving and a second coating different from said first coating and superposed thereon, said second coating comprising a metal compound to improve the wear resistant and corrosion protection properties to present a surface less susceptible to progressive wear during shaving than said first coating.

**4.** A razor blade according to claim **3**, wherein the second coating is a refractory metal compound.

**5.** A razor blade according to claim **3**, wherein the second coating is a nitride.

**6.** A razor blade according to claim **3**, wherein each coating has a thickness of between 50 and 450 Angstroms.

**7.** A razor blade according to claim **3**, wherein said first coating has a thickness of between 70 and 200 Angstroms.

**8.** A razor blade according to claim **3**, wherein said second coating has a thickness of between 50 and 150 Angstroms.

**9.** A razor blade according to claim **3**, wherein a coating of a shaving facilitating polymer is provided on said second coating.

**10.** A razor blade according to claim **3** wherein a coating of a fluorocarbon polymer is provided on said second coating.

**11.** A razor blade according to claim **3**, wherein a coating of polytetrafluoroethylene is provided on said second coating.



**12.** A razor blade according to claim **3**, wherein a coating of a copolymer of thio-carbonyl fluoride and tetrafluoroethylene is provided on said second coating.

**13.** A razor blade having at least one cutting edge carrying two different superposed coatings, the lower one of said coatings being of an alloy and the other of said coatings being a refractory silicon compound.

**14.** A razor blade according to claim **13**, wherein each coating has a thickness of between 50 and 450 Angstroms.

**15.** A razor blade according to claim **13**, wherein said lower coating has a thickness of between 70 and 200 Angstroms.

**16.** A razor blade according to claim **13**, wherein said upper coating has a thickness of between 50 and 150 Angstroms.

**17.** A razor blade according to claim **13**, wherein a coating of a shaving facilitating polymer is provided on said upper coating.

**18.** A razor blade according to claim **13**, wherein a coating of a fluorocarbon polymer is provided on said upper coating.

**19.** A razor blade according to claim **13**, wherein a coating of polytetrafluoroethylene is provided on said upper coating.

**20.** A razor blade according to claim **13**, wherein a coating of a copolymer of thio-carbonyl fluoride and tetrafluoroethylene is provided on said upper coating.

**21.** A razor blade having at least one cutting edge, said cutting edge carrying a first coating selected from the group consisting of platinum, iridium, osmium, palladium, rhodium, ruthenium, titanium, zirconium, vanadium, niobium, tantalum, molybdenum, cobalt, nickel, manganese, rhenium, tungsten and alloys of the foregoing, said first coating having superposed thereon a second coating selected from the group consisting of carbides, borides, oxides, nitrides, silicides and fluorides, alone and mixed, of chromium, silicon, tungsten, molybdenum, cobalt, aluminium, manganese, vanadium, niobium, tantalum, titanium, zirconium, hafnium, rhenium and the rare earths.

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