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(54) **METHOD FOR INCREASING THE DEFINITION, THE BRILLIANCE AND THE LUSTER OF GEMSTONES**

(57) A method for increasing the definition, the brilliance and the luster of gemstones, in which the surface of a gemstone, be it natural, synthetic or imitation, is coated, by way of the use of the process of Physical Vapor Deposition or PVD, with a thin coating which is antireflective to light rays entering the gemstone, for the pur-

pose of decreasing the amount of reflected light and increasing the amount of incoming light, in order to enable a greater clarity and definition of the colors and of the edges of the gemstone and at the same time reduce the reflection.

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Description

[0001] The present invention relates to a method for increasing the definition, the brilliance and the luster of gemstones.

[0002] Physical Vapor Deposition or PVD is the deposition of thin films under a vacuum, and is a very widespread technique for manufacturing electronic devices, but also for application on glass, for example in the sector of ophthalmic lenses or even of mirrors, the latter being obtained by depositing a thin layer of aluminum on a glass sheet.

[0003] The new use of the PVD technique involves applying, on the surface of a gemstone, natural or synthetic, a thin coating which is antireflective to light rays entering such gemstone. This is for the purpose of decreasing the amount of reflected light and increasing the amount of light entering into the gemstone, thus enabling a greater clarity and definition thereof. (The term natural gemstones means, for example: diamond, corundum, beryl, quartz and all gemstones that exist naturally; the term synthetic or imitative gemstones means gemstones created by man.)

[0004] It can be seen, therefore, that while in eyewear, for example, the function of such treatment is to improve visibility through the treated medium, in the field of gemstones its function is merely aesthetic.

[0005] As is known, the process of Physical Vapor Deposition (PVD) is a process of atomic deposition in which the material is evaporated from a solid or liquid source in the form of atoms or molecules and transferred in vapor form by way of a vacuum or plasma environment to the substrate where it condenses. In order to make such material evaporate, it is necessary to provide it with heat or in any case energy. Of the evaporation systems usually used, sputtering is undoubtedly preferable for the new use in question. Sputtering deposition is a PVD process in which the material is vaporized from a surface referred to as the target with a non-thermal vaporization, non-thermal in that the surface atoms of the target are physically extracted from the solid surface thanks to the energy transferred to them by a bombardment of atomic particles. Such bombardment is usually generated by ions created from plasma at low pressure (less than 0.1 Pa) and in this case the particles extracted exhibit a low rate of collisions between the source and the substrate, or from plasma at high pressure (between 0.5 and 3 Pa) where there is a "cooling" of the particles in the gaseous phase before reaching the sample. Furthermore, the plasma can be confined proximate to the target or it can fill the entire region between the source and the substrate and it can be constituted by inert gas (usually argon) or, for reactive sputtering, by nitrogen or oxygen; the presence of the plasma chemically activates such gases, thus creating, in vapor form, compounds with the material evaporated from the target.

[0006] Specifically, the new method developed involves a system of sputtering deposition that uses, as its

target, zirconium metal and metallic silicon. The process is carried out in an oxygen atmosphere thus making it possible to form oxides in gaseous phase for the deposition of the antireflective layers.

5 **[0007]** The process is carried out at low temperatures, for example 40°C and the substrate is turned at a speed of 1 revolution / 2 seconds and is brought close to the target about 60 times, with the possibility of using media made of plastics as well.

10 **[0008]** Another method of deposition of antireflective layers is the evaporation process, which is more versatile because it permits application on substrates of various dimensions. This sputtering process is carried out at higher temperatures, in the region of 200°C, and it is carried out in a vacuum. In this case the targets, which are titanium oxide- and silicon oxide-based, are bombarded by an electron beam.

15 **[0009]** The coating made up of titanium oxide and silicon oxide acts as an antireflective coating, allowing a selected portion of the visible part of the electromagnetic spectrum of light to penetrate into the gemstone with greater ease, thanks to the lower reflection generated on the surface.

20 **[0010]** Such coating can be of different thicknesses and its chemical composition can vary: in addition to the elements cited above, which can vary in proportion and percentage, other elements can be added in order to modify the antireflective properties of the thin layer. In fact, by varying the composition it is possible to program different possible "windows" in the visible part of the spectrum, from 350nm to a maximum of 750nm and, therefore, to obtain different colorings of the outgoing light, where the term "windows" is used to mean the part of the electromagnetic spectrum of light in which the reflection is reduced, while the remaining part outside the "window" is absorbed by the thin layer and does not enter the gemstone.

25 **[0011]** The foregoing description highlights the considerable advantages that the new method in question can bring to the sector of gemstones. In fact, there is a considerable increase in the definition of the colors and of the edges, and also in the clarity, and at the same time reflections decrease, so much so that the treated gemstones could be described as "full HD". Furthermore the treatment is reversible and, therefore, it can be removed if desired without damaging the treated stone.

30 **[0012]** It is clear that, without prejudice to the general characteristics illustrated and described, any modifications or variations, particularly regarding the different thicknesses or the different composition of the coating, will in any case be comprised in the present patent scope.

35 **[0013]** The content of Italian patent application no. RA2014A000014, the priority of which is claimed in the present application, is incorporated as a reference.

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Claims

1. A method for increasing the definition, the brilliance and the luster of gemstones, **characterized in that** the surface of a gemstone, be it natural, synthetic or imitation, is coated, by way of the use of the process of Physical Vapor Deposition or PVD, with a thin coating which is antireflective to light rays entering said gemstone, for the purpose of decreasing the amount of reflected light and increasing the amount of incoming light, in order to enable a greater clarity and definition of the colors and of the edges of the gemstone and at the same time reduce the reflection.
2. The method according to claim 1, **characterized in that**, in order to make the material to be deposited on the gemstone evaporate, in the form of atoms or molecules, from a solid or liquid source, and transfer it, in vapor form, by way of a vacuum or plasma environment to the gemstone where it condenses, the sputtering system is used, said sputtering being a PVD process in which the material is vaporized from a surface referred to as the target with a non-thermal vaporization, non-thermal **in that** the surface atoms of the target are physically extracted from the solid surface thanks to the energy transferred to them by a bombardment of atomic particles.
3. The method according to claim 2, **characterized in that** said sputtering system of deposition uses, as the target, zirconium metal and metallic silicon.
4. The method according to claims 2 and 3, **characterized in that** said process is carried out in an oxygen atmosphere thus making it possible to form oxides in gaseous phase for the deposition of the antireflective layers.
5. The method according to one or more of the previous claims, **characterized in that** the process is carried out at low temperatures, between 20°C and 60°C.
6. The method according to one or more of the previous claims, **characterized in that** the gemstone is turned at a speed comprised between 1 revolution/second and 4 revolutions/ 3 seconds and is brought close to the target from 20 to 100 times.
7. The method according to claim 2, **characterized in that** said sputtering system of deposition uses targets based on titanium oxide and silicon oxide which are bombarded by an electron beam.
8. The method according to claim 7, **characterized in that** the process is carried out at a temperature between 100°C and 300°C.
9. The method according to claims 7 and 8, **character-**
- ized in that** the process is carried out in a vacuum.
10. The method according to claim 1, **characterized in that** said antireflective coating can have different thicknesses and its chemical composition can vary on the basis of the percentage of the various elements that make it up.



EUROPEAN SEARCH REPORT

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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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