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GLOSSING CORUNDUM AND SPINEL

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Fig. 1.

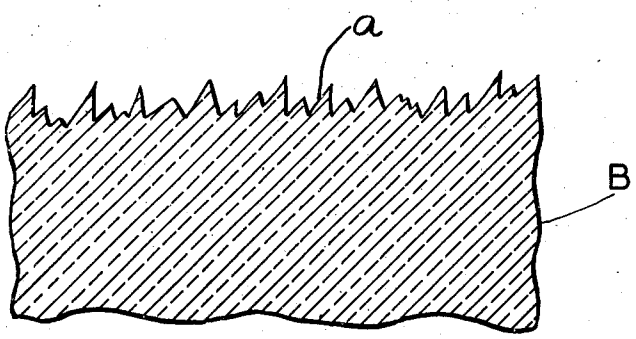


Fig. 2.

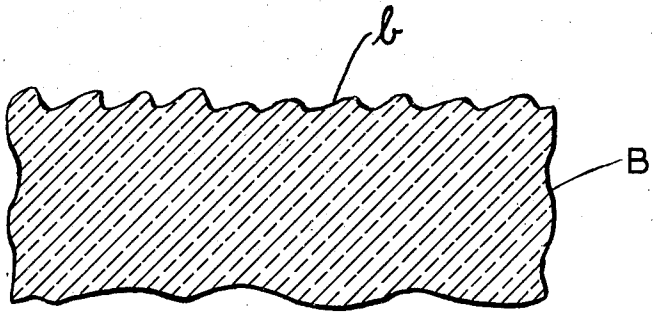
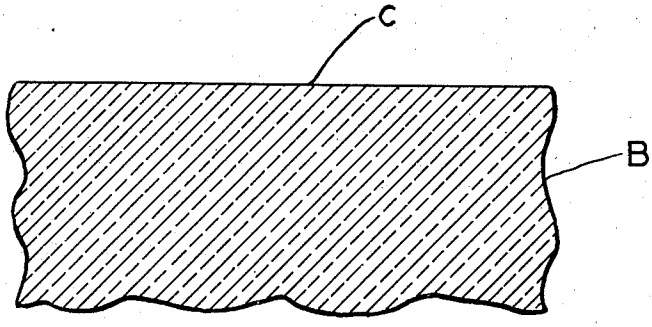


Fig. 3.



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GLOSSING CORUNDUM AND SPINEL

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This invention is a process for providing glossy scratch-free surfaces on crystalline incombustible precious and semiprecious stones, particularly crystalline bodies of synthetic corundum and spinel. The invention also relates to precious and semiprecious stones having glossy scratch-free surfaces.

Most precious and semiprecious stones have rough surfaces when found in nature or when synthesized. For example, unicrystalline rods and boules of synthetic corundum and spinel, in the as-grown condition, have a matte or frosted surface composed of many microscopic sharp and angular crystal facets. Also, when stones are sawed or ground, their surfaces are covered with scratches caused by particles of abrasive material. Before a stone may be used as a jewel bearing, thread, guide, or other low-friction wear-resistant device, it must be given a glossy surface. Heretofore, stones have been mechanically polished by rubbing them with successively smaller particles of diamond or like abrasive. While mechanically polished surfaces may appear to be smooth and uniform when viewed with the naked eye, a microscope reveals the existence of many small scratches produced by the small particles of abrasive. Furthermore, mechanical polishing is a slow, tedious, and expensive process.

The principal object of the present invention is the provision of a novel process for rapidly and inexpensively treating crystalline precious and semiprecious stones, such as corundum and spinel, to give them glossy and scratch-free surfaces. Another object is the provision of such a process wherein glossing is accomplished by using both heat and addition agents. Another object is to provide a novel process for glossing stones whereby the character of the surface finish may be accurately controlled. Other objects are the provision of: crystalline precious and semiprecious stones having glossy and scratch-free surfaces; and rods, such as synthetic corundum and spinel, having substantially even, glossy, and scratch-free surfaces; and rods having glossy but wavy surfaces.

The above and other objects, and the novel features of the invention, will become apparent from the following description, having reference to the accompanying drawing, wherein Figs. 1, 2, and 3 are highly magnified schematic longitudinal sectional views of, respectively, a synthetic stone rod in the as-grown condition, a similar rod partially glossed by the process of the invention, and a fully glossed similar rod.

The process of the invention is carried out by first applying to the surface of the stone a thin film of an addition agent, advantageously adding just enough to fill the pits and crevices in the surface. It is advantageous to use at least one oxide

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or oxide-forming compound fulfilling at least one of the following requirements: having a lower melting point than the stone, forming a eutectic with the stone, forming a solid solution with the stone, and forming a low melting peritectic with the stone. Then the film is bonded to the original surface by fusion with heat, as in a gas flame, an electric arc, or a furnace. Either a fully glossed, even surface, as at *c* in Fig. 3, or a partially glossed, wavy surface, as at *b* in Fig. 2, can be obtained by properly controlling the heating. Oxides suitable for glossing stones, such as spinel and corundum, include calcium oxide, magnesia, sodium oxide, and silica (silicon dioxide). The oxides of calcium, magnesium, and sodium form eutectics with corundum and spinel. Silica and sodium oxide have lower melting points than corundum and spinel. Magnesia forms a solid solution with corundum prepared from beta alumina. Silica also forms a low melting peritectic with corundum and spinel.

One way to apply the oxide is to paint on the surface of the stone a slurry or solution in water or other liquid of the oxide, or a compound decomposable to form the oxide. By way of example, a synthetic clear sapphire (pure alumina) was glossed by wetting its surface with a lime solution, evaporating the lime solution to dryness, and heating at about 1500° C. for one minite in an oxy-hydrogen flame. Oxide also may be applied in the molten condition.

An alternative method for applying the thin film of oxide is to vaporize the oxide, and condense the vapor upon the surface of the stone. This may be done in an evacuated vessel within which the oxide is vaporized by an electrically heated tungsten filament, as described by Heidenrich and Peck in Journal of Applied Physics, vol. 14, page 26 (1943). The coated stone then is placed within a furnace, or heated in a flame or arc to form a glossy surface.

Sometimes it is desirable to shape the stone by mechanical cutting or grinding prior to heat glossing the surface. For example, synthetic corundum and spinel rods sometimes are ground to uniform diameter in a centerless grinder, after which the ground surfaces are glossed by the novel process of the invention.

Synthetic unicrystalline corundum rods heat glossed by the process of the invention had an average tensile strength of 102,000 lb./sq. in., compared with 67,000 lb./sq. in. for similar rod in the as-grown condition. This is believed traceable to the elimination of a notch effect existing in the unglossed rod. Furthermore, the hardness of rod glossed by the process of the invention was about the same as the hardness of mechanically polished rod. For example, the previously mentioned clear synthetic sapphire treated with a lime solution had a Knoop hard-

ness of 1780 after glossing by heating, which is comparable to the hardness of mechanically polished corundum, namely 1600 to 2100.

Crystalline precious and semiprecious stones treated by the process of the invention have glossy, clear, and scratch-free surfaces which render them useful for many purposes. For example, fully heat glossed stones, such as unicrystalline synthetic corundum and spinel, are useful as jewel bearings. Heat glossed synthetic spinel and corundum rods also may be used as thread guides and tension posts in textile mills. Partially glossed synthetic corundum and spinel rods, having a wavy surface, are particularly useful as thread guides and tension posts because the slightly wavy surfaces provide a series of grooves within which the thread may run.

The process of the invention has been described specifically by way of illustration only. It is apparent, however, that variations in procedure may be made within the spirit and scope of the invention, as defined in the claims.

What is claimed is:

1. A process for glossing a unicrystalline body of material selected from the group consisting of corundum and spinel comprising applying to a rough surface of such a body in thin film of at least one substance selected from the group consisting of metal oxides and substances forming metal oxides fulfilling at least one of the following requirements: having a melting point lower than such material forming a eutectic with such material, forming a low melting peritectic with such material, and forming a solid solution with such material; and subsequently heat bonding such film to said surface.

2. A process for glossing a unicrystalline body of material selected from the group consisting of corundum and spinel comprising applying to a rough surface of such a body a thin film of a slurry including at least one substance selected from the group consisting of metal oxides and substances forming metal oxides fulfilling at least one of the following requirements: having a melting point lower than such material, forming a eutectic with such material, forming a solid solution with such material, and forming a low melting peritectic with such material; and fusing such film to said surface.

3. A process for glossing crystalline precious and semiprecious stones selected from the group consisting of unicrystalline corundum and spinel comprising vaporizing at least one metal oxide fulfilling at least one of the following requirements: having a melting point lower than such a stone, forming a eutectic with such a stone, forming a low melting peritectic with such a stone, and forming a solid solution with such a stone; condensing a thin film of the oxide vapor on a rough surface of such a stone; and fusing such film to said surface.

4. A unicrystalline corundum body having a glossy scratch-free surface, said body having small surface pits and crevices, said body having bonded thereto over a substantial surface area a film of fused oxide selected from those of calcium, silicon, magnesium, and sodium, said pits and crevices being filled with such fused oxide, said surface having a Knoop hardness of at least 1600.

5. A unicrystalline spinel body having a glossy scratch-free surface, said body having small surface pits and crevices, said body having bonded thereto over a substantial surface area a film of fused oxide selected from those of calcium, silicon, magnesium, and sodium, said pits and crevices being filled with such fused oxide.

6. A unicrystalline body of material selected from the group consisting of corundum and spinel having bonded thereto over a substantial surface area a film of metal oxide fulfilling at least one of the following requirements: having a melting point lower than such material, forming a eutectic with such material, forming a solid solution with such material, and forming a low melting peritectic with such material, said body having a glossy scratch-free surface.

7. A body as claimed in claim 6, wherein such oxide comprises calcium oxide.

8. A body as claimed in claim 6, wherein such oxide comprises silicon dioxide.

9. A unicrystalline body of material selected from the group consisting of corundum and spinel having bonded thereto over a substantial surface area a film of metal oxide fulfilling at least one of the following requirements; having a melting point lower than such material, forming a eutectic with such material, forming a solid solution with such material, and forming a low melting peritectic with such material.

10. A unicrystalline corundum body having small surface pits and crevices, said body having bonded thereto over a substantial surface area thereof a film of fused oxide selected from those of calcium, silicon, magnesium, and sodium, said pits and crevices being filled with such fused oxide, said oxide-filmed surface area having a Knoop hardness of at least 1600.

11. A process in accordance with claim 1 wherein said metal is calcium.

12. A process in accordance with claim 1 wherein said metal is silicon.

13. A process in accordance with claim 1 wherein said metal is magnesium.

14. A body as claimed in claim 6, wherein such oxide comprises magnesia.

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