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REFRACTORY

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1 Claim. (Cl. 25—156)

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The present invention relates to novel and improved refractory articles for use at high temperatures and to a novel and improved process of producing such articles.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the processes, steps, instrumentalities and combinations pointed out in the appended claim.

The invention consists in the novel steps, processes, parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate refractory articles in accordance with this invention and as produced by the process of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Figure 1 is a schematic side elevation showing a typical and illustrative resistance heating element in accordance with the present invention; and

Figure 2 is a vertical sectional view.

The present invention has for its object the provision of a novel and improved process of forming and producing refractory bodies from powdered molybdenum silicide for use at relatively high temperatures under oxidizing as well as other conditions. A further object is the provision of novel and improved refractory articles for varied uses and which will withstand oxidization at high temperatures and are not seriously eroded or corroded by most agents. Still another object is the provision of an improved refractory body which can be simply and economically manufactured in quantity. The invention further provides a refractory body which can be easily manufactured in relatively complex shapes, as well as in the form of rods, bars and tubes and which lends itself to a wide variety of uses where oxidation, erosion and corrosion resistance at high temperatures is desired.

Heretofore, many different alloys have been proposed for the manufacture of refractory articles, but almost all of them have required casting at extremely high temperatures, have been inordinately expensive, or have been incapable of substantially resisting erosion, corrosion and oxidation at high temperatures.

Although the molybdenum silicides have been known as chemical compounds or alloys for over fifty years, their industrial application up to the present has been limited to their use as addition agents for introducing molybdenum and silicon into ferrous and other alloys, and aside from that use they have remained interesting laboratory curiosities.

Molybdenum silicides do not readily lend themselves to the production of shaped articles by ordinary methods of casting or machining and the cast material is not sound, is porous and many large voids occur in the castings so that it is impractical to produce strong refractory objects from the cast metal or alloy.

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I have now found that molybdenum silicide possesses the unusual property of being stable in oxidizing atmospheres at temperatures as high as about 1700° C. and that it is also resistant to the usual erosive and corrosive agents at high temperatures and by the process of the present invention, refractory articles may be readily, easily and economically produced from such molybdenum silicide.

In carrying out the process of the present invention crushed and powdered molybdenum silicide is mixed with a small proportion of an organic binder and with enough water to form a stiff composition which is then formed or molded to the desired shape, after which the formed articles are air dried and then are heated to ignite the binder and to sinter the remaining molybdenum silicide into a dense, strong mass which is substantially resistant to most of the usual eroding and corroding agents at ordinary and elevated temperatures. Due to the extraordinarily simple manner in which the molybdenum silicide may be formed and treated many refractory articles may be prepared much more economically than otherwise, and in many instances, the process of the present invention provides the most practical manner of forming many such objects of complex shape.

While molybdenum monosilicide (MoSi) and molybdenum sesquisilicide (Mo_2Si_3) may be used in putting the present invention into practice, I prefer to use the molybdenum bisilicide ($MoSi_2$) due to its noble character and its great stability at temperatures up to its melting point. When heated to high temperatures (from about 1000° C. 1700° C.) any excess of molybdenum or silicon occurring in the metallic compound or alloy is volatilized leaving the pure molybdenum silicide as a noble, refractory mass.

Any desired organic binder may be used which has the requisite strength to hold the powdered mass together while it is drying and sintering. Among the suitable binders are starch, flour, glue, gelatin, ethyl cellulose, cellulose acetate, with the appropriate solvents or swelling agents to render the binder adhesive and also to render the mixture of molybdenum silicide and binder moldable.

The molybdenum silicide is preferably crushed and ground to provide a relatively fine powder which is usually sufficiently fine to pass through a 200 mesh sieve. To the required amount of powder is added from ½ to 4% of the binder, and preferably about 1% of corn flour together with enough water, about 10 to 12% to form a stiff mud-like mass which can be manipulated, molded and shaped in the manner of ceramic clay.