[15] The weight ratio of the yttrium compound to the magnesium compound in the composite may be 1:9 to 9:1.

[16] The composite may show a maximum frequency peak at 200 nm or less in the EBSD grain size distribution.

[17] The composite may show a maximum frequency peak at 100 nm or less in the EBSD grain size distribution.

[18] The composite may further contain Al_2O_3.

[19] The yttrium compound may include YF3 or Y-O-F.

[20] In accordance with another aspect of the present disclosure, a method for manufacturing a plasma sprayed coating may include: (a) introducing a feedstock powder containing yttrium and magnesium sources into a plasma stream to melt at least a portion of the feedstock powder; and (b) exposing a substrate to an atmospheric plasma stream containing the yttrium and magnesium sources to form a plasma sprayed coating containing a composite of a magnesium compound and an yttrium compound.

[21] In step (a), the yttrium and magnesium sources may be composed of a mixture of yttrium oxide and magnesium oxide.

[22] In the magnesium and yttrium sources, the weight ratio of magnesium and yttrium, converted to MgO and Y2O3, may be 1:9 to 9:1.

[23] The yttrium and magnesium sources may contain cubic yttria.

[24] The composite may contain a monoclinic yttrium oxide.

[25] The monoclinic yttrium oxide may constitute the main phase of crystalline yttrium oxide.

[26] The yttrium compound may further contain a cubic yttrium oxide.

【Advantageous Effects】

[27] According to the present disclosure, a plasma sprayed coating containing a Y_2O_3-based composite with a low average grain size can be provided. Furthermore, a high-hardness plasma sprayed coating containing a Y_2O_3-based composite can be provided.

【Description of Drawings】

[28] FIG. 1 schematically shows a plasma spray apparatus according to an exemplary embodiment of the present disclosure.

[29] FIGS. 2A and 2B show graphs of X-ray diffraction analysis results of sprayed coating specimens manufactured according to an exemplary embodiment of the present disclosure.

[30] FIGS. 3A and 3B show JCPDS XRD patterns of cubic Y2O3 and monoclinic Y2O3.

[31] FIGS. 4A and 4B show images of EBSD maps for a specimen manufactured

$Y_6O_5F_8$, $Y_5O_4F_7$, and $Y_4O_3F_6$. In the present disclosure, the yttrium compound may contain two or more cations. For example, the yttrium compound may contain at least one element selected from the group consisting of Al, Zr, Y, Sm, Dy, Er, and Hf.

[39]

[40] Therefore, the yttrium compound in the present disclosure may include yttrium aluminate, such as $Y_4Al_2O_9$, $Y_3Al_5O_{12}$, or $YAlO_3$, or yttria-stabilized zirconia. Meanwhile, the magnesium compound in the present disclosure is interpreted in the same manner. For example, the magnesium compound may include a fluoride, such as Mg-O-F or MgF_2, in addition to MgO. Additionally, the magnesium compound may include a ternary compound such as $MgAl_2O_4$, or multi-component compounds having more cations and anions.

[41]

[42] Hereinafter, a manufacturing method of a plasma sprayed coating containing a composite of magnesium and yttrium compounds will be described.

[43] In the present disclosure, the thermal sprayed coating may preferably be implemented by plasma spraying. Hereinafter, atmospheric plasma spraying is described for a method for forming the thermal sprayed coating of the present disclosure, but the present disclosure is not limited thereto. For example, other thermal spraying methods, such as low-pressure plasma spraying or suspension plasma spraying, may be used.

[44] The atmospheric plasma spray (APS) is a thermal spray technique in which a powder or linear material is changed into molten droplets by a high-temperature thermal source, allowing the droplets to be impacted onto a substrate at a high speed, followed by rapid cooling, thereby forming a layered coating. More specifically, APS is a technique in which a gas, such as Ar, He, or N_2, is converted into plasma by an atmospheric arc, and ejected through a nozzle to form a coating by using ultra-high-temperature, high-rate plasma jet as a heat source, wherein a thermal spray material is impacted onto a substrate, which is a material to be treated, at high speed, thereby enabling the formation of a coating with high adhesion strength and high density.

[45] FIG. 1 schematically shows a plasma spray apparatus according to an embodiment of the present disclosure.

[46] Referring to FIG. 1, a plasma spray apparatus 100 includes a plasma torch 110 or a plasma gun, and a feedstock powder injector 120. The apparatus may also include a stage 140 configured to mount a substrate 12 for coating formation thereon.

[47] In the present disclosure, the substrate 12 may be composed of any material. For example, a material, such as aluminum, Al_2O_3, quartz, stainless steel, AlN, or Y_2O_3, may be used.

[48] In the present disclosure, the substrate 12 may be a substrate used for components for a semiconductor process such as plasma etching, for example, a nozzle, an injector, a focus ring, an edge ring, a cover ring, an electrostatic chuck, a heater, and a liner.

[49] In the present disclosure, the separation distance between the plasma torch and the substrate may be appropriately set. In the present disclosure, the separation distance indicates the distance from a nozzle 112 of the plasma torch to the surface of the substrate 12, and the separation distance is preferably maintained in the range of 130 to 160 mm in order to provide molten powder droplets without loss, thus improving the yield.

[50] The plasma torch 110 is configured to generate an arc discharge between a negative electrode and a positive electrode while flowing a large volume of gas, thereby spraying plasma in a jet state. The plasma sprayed from the plasma torch forms a plasma stream toward the substrate. A feedstock powder, when injected into the plasma stream, may be melted in a short time.

[51] In the present disclosure, the feedstock powder injector 120 is configured to supply a feedstock powder as a material for a thermal sprayed coating. The present disclosure contains yttrium and magnesium sources as the feedstock powder from the injector. In the present disclosure, an yttrium salt and a magnesium salt or an yttrium magnesium salt may be used as the yttrium and magnesium sources. Preferably, the yttrium and magnesium sources may be in the form of an oxide, but are not limited thereto, and appropriate sources capable of forming yttrium and magnesium compounds after thermal spray may be used. In addition, the sources may be composed of an yttrium oxide and a magnesium oxide, or may contain an yttrium magnesium oxide.

[52] In the present disclosure, the feedstock powder may be a powder molded in the form of granules. The feedstock may be, for example, a molded body obtained by spray drying of a powder of yttrium oxide and magnesium oxide. Additionally, the feedstock powder may be prepared by melting a portion of the spray-dried molded body through heat treatment or plasma treatment.

[53]

[54] The present disclosure provides a plasma sprayed coating containing a composite of a magnesium compound and an yttrium compound. In the present disclosure, the composite of the coating may contain a monoclinic yttrium oxide.

[55] As described below, the yttrium oxide is a compound having a cubic crystal structure in a stable state. The composite coating of the present disclosure contains a monoclinic yttrium oxide, and preferably contains, as a main phase, a monoclinic yttrium oxide among the crystalline yttrium oxides. In the present disclosure, the term "main phase" refers to a phase, of which the weight fraction is 50% or more among the phases constituting a specific compound. According to an embodiment of the present disclosure,

intensity at the same angle.

[72]

[73] TABLE 4

Classification	Composition	Crystalline structure	Peak position (°)	Measured intensity (Count, x10^3)	Base (Count, x10^3)	Absolute intensity (Count, x10^3)	Fraction (wt%)
#1	Y_2O_3	Cubic	29.27	6.38	0.01	6.37	100
#2	Y_2O_3	Monoclinic	28.91	3.04	1.62	1.42	8
			30.72	3.51	1.58	1.93	
	MgO	Cubic	42.96	21.37	1.37	20.00	92
#3	Y_2O_3	Cubic	29.23	8.38	3.65	4.73	9
		Monoclinic	28.86	8.06	3.67	4.39	27
			30.77	7.95	3.65	4.30	
	MgO	Cubic	42.89	13.71	3.35	10.36	64

[74] As shown in Table 4, the Y_2O_3 grains of Specimen #1 had a cubic crystal structure showing a peak around $2\theta = 29.3°$. However, the Y_2O_3 grains of Specimen #2 had a monoclinic crystal structure showing peaks around $2\theta = 28.9°$ and 30.7°. Specimen #3 also had, as a main phase, monoclinic Y_2O_3 showing peaks at similar positions.

[75]

[76] The crystal structures and grain sizes of the thermal sprayed coatings obtained were analyzed by EBSD. The EBSD analysis was conducted using the e-Flash FS model from Bruker Optik GmbH. Specifically, the measurement was conducted at a magnification of 10,000x, with a scanning area of 20.76 x 15.52 μm^2 and a resolution of 500 x 375 pixels.

[77] FIGS. 4A and 4B show images of EBSD maps for Specimen #1, where FIG. 4A shows an image of the crystal structure, and FIG. 4B shows an image of the crystallographic orientation. In each image, the black background indicates a non-measurable area.

[78] Referring to FIG. 4A, Specimen #1 was composed of cubic yttria. In addition, FIG. 4B shows the crystallographic orientations of the grains within the area shown in FIG. 4A using shading, where a part appearing as a single large area in FIG. 4A is actually composed of fine grains with different crystallographic orientations, such as (100), (111), and (001).

[79] FIGS. 5 and 6 show images of EBSD maps for Specimen #3, where FIG. 5 shows an image of the crystal structure, and FIG. 6 shows an image of the crystallographic orientation. In FIGS. 5 and 6, the black background indicates a non-measurable area.

[80] As shown in FIG. 5, the Y_2O_3 phase of Specimen #3 was composed of a monoclinic crystal structure and a cubic crystal structure, where the grains of the monoclinic crystal structure accounts for a wider area than the grains of the cubic crystal