CLAIMS

[Claim 1]

A coated steel product having a steel product and a coating layer including a Zn-Al-Mg alloy layer disposed on a surface of the steel product,

wherein the Zn-Al-Mg alloy layer has a Zn phase, and the Zn phase includes a Mg-Sn intermetallic compound phase,

wherein, in a cross-section of the Zn-Al-Mg alloy layer, the Zn phase including the Mg-Sn intermetallic compound phase is present with an area fraction of 3% or more with respect to the cross-section of the Zn-Al-Mg alloy layer,

wherein the coating layer consists of, in terms of percent (%) by mass:

Zn: more than 65.0%,

Al: from more than 5.0% to less than 25.0%,

Mg: from more than 3.0% to less than 12.5%,

Sn: from 0.1% to 20.0%,

Bi: from 0% to less than 5.0%,

In: from 0% to less than 2.0%,

Ca: from 0% to 3.00%,

Y: from 0% to 0.5%,

La: from 0% to less than 0.5%,

Ce: from 0% to less than 0.5%,

Si: from 0% to less than 2.5%,

Cr: from 0% to less than 0.25%,

Ti: from 0% to less than 0.25%,

Ni: from 0% to less than 0.25%,

Co: from 0% to less than 0.25%,

V: from 0% to less than 0.25%,

Nb: from 0% to less than 0.25%,

Cu: from 0% to less than 0.25%,

Mn: from 0% to less than 0.25%,

Fe: from 0% to 5.0%,

Sr: from 0% to less than 0.5%,

Sb: from 0% to less than 0.5%,

Pb: from 0% to less than 0.5%,

B: from 0% to less than 0.5%, and

impurities, and

wherein the coating layer has a chemical composition that satisfies the following Formulas 1 to 5:

Formula 1: $Bi + In < Sn$

Formula 2: $Y + La + Ce \leq Ca$

Formula 3: $Si < Sn$

Formula 4: $0 \leq Cr + Ti + Ni + Co + V + Nb + Cu + Mn < 0.25$

Formula 5: $0 \leq Sr + Sb + Pb + B < 0.5$

wherein, in Formulas 1 to 5, each element symbol represents a content of a corresponding element in terms of percent (%) by mass.

[Claim 2]

The coated steel product according to claim 1, wherein the Mg-Sn intermetallic compound phase has an average grain size of less than 1 μm.

[Claim 3]

The coated steel product according to claim 1 or 2, wherein, in a cross-section of the Zn-Al-Mg alloy layer, the Mg-Sn intermetallic compound phase having a grain size of less than 1 μm has an area fraction of from 10% to 50% with respect to the Zn phase including the Mg-Sn intermetallic compound phase.

[Claim 4]

The coated steel product according to any one of claims 1 to 3, wherein, based on an X-ray diffraction image of a surface of the coating layer, the image being measured using a Cu-Kα ray with an X-ray output at 40 kV and 150 mA, a specific intensity I (Mg-Sn intermetallic compound phase) ={I (22.8° intensity (cps)) + I (23.3° intensity (cps)) + I (24.2° intensity (cps))}/3 × I (background intensity at 20° (cps)) is 1.5 or more.

[Claim 5]

The coated steel product according to any one of claims 1 to 4, wherein the coating layer has a Ca content of from 0.05% to 3.00% by mass, and the Zn phase contains, as the Mg-Sn intermetallic compound phase, a MgCaSn phase and a Mg_9Sn_5 phase,

wherein, based on an X-ray diffraction image of a surface of the coating layer, the image being measured using a Cu-Kα ray with an X-ray output at 40 kV and 150 mA, a specific intensity I (MgCaSn + Mg_9Sn_5)={I (22.8° intensity (cps)) + I (26.3° intensity (cps))}/I (23.3° intensity (cps)) is less than 0.3, and I (23.3° intensity (cps)) is 500 cps or more.

[Claim 6]

The coated steel product according to claim 4, wherein the coating layer has a Mg content of from more than 4.0% to less than 12.5% by mass, a Ca content of from 0.05% to 3.00% by mass, and an Si content of from 0.01% to 2.5% by mass,

wherein, based on the X-ray diffraction image of the surface of the coating layer, the

image being measured using a Cu-Kα ray with an X-ray output at 40 kV and 150 mA, a diffraction peak having a strongest intensity among diffraction peaks appearing at from 23.0° to 23.46° appears between 23.36° to 23.46°.

[Claim 7]

The coated steel product according to any one of claims 1 to 6, wherein the coating layer has a Ca content of from 0.05% to 3.00% by mass and an Si content of from 0.01% to 2.5% by mass,

wherein the Zn-Al-Mg alloy layer has at least one selected from the group consisting of a Ca-Al-Si intermetallic compound phase having an average grain size of 1 μm or more and a Mg-Al-Si intermetallic compound phase having an average grain size of 1 μm or more.

[Claim 8]

The coated steel product according to any one of claims 1 to 7, wherein the coating layer has a Ca content of 0.05% to 3.00% by mass,

wherein, in a cross-section of the Zn-Al-Mg alloy layer, a Ca-Zn-Al intermetallic compound phase having a grain size of 1 μm or more is present with an area fraction of 5% or more with respect to the cross-section of the Zn-Al-Mg alloy layer.

[Claim 9]

The coated steel product according to any one of claims 1 to 8, wherein the coating layer has an Sn content of from 3.00% to 20.00% by mass, and, the following Formula is satisfied:

$0.05 < Sn/Zn$, wherein each of Sn and Zn represents the content of the corresponding element,

wherein, in a cross-section of the Zn-Al-Mg alloy layer, a Mg-Sn intermetallic compound phase having a grain size of 1 μm or more is present with an area fraction of 3% or more with respect to the cross-section of the Zn-Al-Mg alloy layer.

[Claim 10]

The coated steel product according to any one of claims 1 to 9, wherein, in a cross-section of the Zn-Al-Mg alloy layer, a eutectoid structure composed of a Zn phase and an Al phase, and having a lamellar spacing of less than 300 nm, is present with an area fraction of 10% or more with respect to the cross-section of the Zn-Al-Mg alloy layer.

[Claim 11]

The coated steel product according to any one of claims 1 to 10, wherein a Zn-Al-$MgZn_2$ ternary eutectic structure has an area fraction of from 0% to 5% in a cross-section of the Zn-Al-Mg alloy layer.

[Claim 12]

The coated steel product according to any one of claims 1 to 8, wherein an Sn content of the coating layer is from 0.10% to less than 3.00%.

[Claim 13]

The coated steel product according to any one of claims 1 to 12, wherein the coating layer has an Al-Fe alloy layer between the steel product and the Zn-Al-Mg alloy layer.