oxide film is resistant to the abrasion of a member by a plasma having high physical energy and hence is capable of improving plasma resistance. The vacuum chamber elements require also sufficiently high mechanical strength and elongation, and colour uniformity and a high breakdown voltage after anodization.

US patent document US-2012/0325381-A1 discloses a manufacturing process for a block of aluminium at least 250 mm thick designed for manufacture of an element for a vacuum chamber, the method comprises casting a block of a given 6XXX-series aluminium alloy, optionally homogenizing said cast block, performing a solution heat treatment directly on the cast and optionally homogenized block, quenching the block, stress relieving of the quenched block by means of cold compression, followed by artificial ageing to a T652 condition. A key element of the disclosed process is that prior to the solution heat treatment the block has not been hot or cold worked to reduce its thickness. The resultant plate product is a so-called “cast plate”. A disadvantage of cast plate is that the unavoidable phases resulting from the combination and precipitation at grain boundaries of elements like iron, manganese, magnesium, and silicon, often in an eutectic form after solidification, cannot be fully dissolved in the subsequent processing steps like homogenization and solution heat treatment and remain as sites for crack initiation, thus significantly lowering the mechanical properties (e.g., ultimate tensile strength, elongation, toughness, and others), or as initiators of local corrosion (e.g. pitting corrosion) and are harmful also for final treatments like anodization which is of particular relevance for vacuum chamber elements. Any oxide layer present within the cast alloy will also remain in its original shape therefore also lowering the mechanical properties. Although cast plate products might be produced more cost effective, because substantially the as-cast microstructure is maintained, and strongly depends on the local cooling speed during the casting operation, there is much more variation in mechanical properties as function of the testing location as compared to rolled plate products, rendering cast plates less suitable for many critical applications.

SUMMARY

In one aspect of the present disclosure, there is provided a method of manufacturing an aluminium alloy plate for vacuum chamber elements, valves, or total assemblies, the method comprising the steps of:

(a) providing a rolling feedstock material of an Al-Mg-Si aluminium alloy having a composition comprising of, in wt.%,

Mg 0.80% to 1.05%,

Si 0.70% to 1.0%,

Mn 0.70% to 0.90%,

Fe up to 0.20%,

Zn up to 0.08%,

Cu up to 0.05%,

Cr up to 0.03%,

Ti up to 0.06%,

unavoidable impurities each <0.03%, total <0.10%, balance aluminium;

(b) homogenizing of the rolling feedstock at a temperature in a range of 550°C to 595°C;

(c) hot-rolling of the homogenized rolling feedstock in one or more rolling steps to a hot-rolled plate having a thickness of at least 10 mm;

(d) solution heat-treatment ("SHT") of the hot rolled plate at a temperature in a range of 540°C to 590°C;

(e) rapid cooling the SHT plate;

(f) stretching of the cooled SHT plate to obtain a permanent elongation from 1% to 5%; and

(g) artificial ageing of the stretched plate.

In another aspect of the present disclosure, there is provided a method of manufacturing an aluminium alloy plate for vacuum chamber elements, valves, or total assemblies, the method comprising the steps of:

(a) providing a rolling feedstock material of an Al-Mg-Si aluminium alloy having a composition comprising of, in wt.%,

Mg 0.70% to 1.05%;

Si 0.70% to 1.0%;

Mn 0.60% to 1.0%;

Fe up to 0.20%;

Zn up to 0.2%;

Cu up to 0.10%;

Cr up to 0.05%;

Ti up to 0.1%;

Ni up to 0.06%;

unavoidable impurities each <0.05%, total <0.15%, balance aluminium;

(b) homogenizing of the rolling feedstock at a temperature in a range of 550°C to 595°C;

(c) hot-rolling of the homogenized rolling feedstock in one or more rolling steps to a hot-rolled plate having a thickness of at least 10 mm;

(d) solution heat-treatment ("SHT") of the hot rolled plate at a temperature in a range of 540°C to 590°C;

(e) rapid cooling the SHT plate;

(f) stretching of the cooled SHT plate to obtain a permanent elongation from 1% to 5%; and

(g) artificial ageing of the stretched plate.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a sample light microscope image for analysing the phases and particles of the aluminium alloy materials described herein.

DESCRIPTION OF THE INVENTION

As will be appreciated herein below, except as otherwise indicated, aluminium alloy designations and temper designations refer to the Aluminium Association designations in