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ELECTRODE, PARTICULARLY FOR ELECTROLYTIC DEVICES

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The invention relates to electrodes, and more particularly those for electrolytic devices, such as condensers.

It is an object of the invention to provide an electrode which is capable of developing a larger active surface than heretofore.

It is another object of the invention to facilitate the increasing of an electrode surface, and thereby the capacity of a condenser made thereof.

It is a particular object of the invention to render a chemical or electro-chemical etching process of such an electrode more efficient.

It is known to roughen the surface of electrodes for electrolytic devices, such as condensers, in order to increase their capacity. Mechanical, chemical, and electrolytical processes have been suggested and used for such roughening of those surfaces. It has been observed that the effect of such roughening depends largely on the quality, in particular purity, of the used electrode material.

It has been found that for instance aluminum, which is preferably used as electrode material for condensers and similar devices, is the less liable of being attacked by chemical agencies the higher its chemical purity is. While aluminum of, e. g., 99.80% purity is dissolved by 12% hydrochloric acid within two hours, aluminium of 99.99% purity remains undissolved in the same medium even after 48 hours.

It has been proposed to use certain grades of pure aluminum for electrodes in electrolytic condensers, in particular if these electrodes have been roughened in order to increase the capacity of the condenser to be made thereof.

According to the present invention two or more different grades of material are composed to form the desired electrode material.

In particular, according to this invention different grades of the material as to purity are compounded.

Electrodes substantially consisting of a material according to this invention are better, or easier, or more efficiently to be etched than an electrode consisting of a component material only. I do not wish to confine myself to any theory. It seems to be obvious, however, that such a compound electrode can be more easily and better attacked by a roughening, in particular etching process because the intentional inhomogeneity of the material facilitates mechanical and chemical attacks thereon, and its structure is less resistive against them than a homogeneous component alone. In addition thereto, components of the material which are more attackable by a chemical will be more easily and quickly dissolved and thereby removed from the surface of the compounded body than other components which are less attackable, thereby leaving a kind of net formed by the latter components on the surface of the body. Such a net has larger surface development than obtainable by etching one of the component materials under similar conditions.

If, for instance, an electrode composed of aluminum grades of different degrees of purity is used, a surface of this electrode is attacked by etching to a different extent, and therefore becomes very rifted.

In this way a good and satisfactory roughening can be obtained even with etching solutions which ordinarily attack aluminum only to a small extent and do not roughen, but entirely dissolve it. The rough surface is formed in such a case thereby that the less pure and therefore more attackable grade of aluminum is dissolved faster than the purer grade of aluminum.

According to a particular feature of the invention two grades of aluminum are used for the electrode, preferably of 99.80% and 99.99% purity.

A composite body or alloy suitable for the invention is preferably made by kneading grades of aluminum of 99.80% and 99.99% purity, these components being used in a ratio of 2:1, 1:1 or 1:2. In such kneaded alloys or mixtures particles of the grades of different purity are present to a large part side by side.

Such kneaded alloys can be made, e. g., in such a way that the selected grades of aluminum are mixed at about 930° F. in a plastic or pulp-like state. The temperature has preferably to be kept below the melting point of the grades of aluminum used.

In order to further increase the extent of roughening more than two different grades of aluminum may be used and, in particular, be composed by kneading.

The roughening of the electrode can be effected by means of any suitably electrolytical, mechanical and/or chemical processes.

The following is the procedure in manufacturing an electrolytical condenser using an electrode according to the present invention:

The electrode material is prepared by compounding two or more different grades of the selected material, and thereupon transformed into the desired shape. Thus, for instance, the compounded material is rolled into a thin sheet and subjected to mechanical and/or chemical treatment.

The mechanical treatment can consist, e. g., in sandblasting the sheet, whereby grades of metal present in the surface which are less resistive against the mechanical attacks of the sandblast are removed to a higher degree than grades of metal present in the surface which are mechanically more resistive. If a chemical etching process is used, again the grades of metal present in the metal which are less resistive to the attacks

of the etching chemicals will be removed or dissolved to a higher degree than the grades of metal present in the surface which are more or perfectly resistive.

Thereby an electrode is obtained, the surface of which is substantially formed by a kind of net constituted by the grades of metal which are more resistive against mechanical and/or chemical attacks. The holes of this net have been formed substantially in that the grades of metal previously filling these holes were removed by mechanical or chemical treatment. Thereby a considerable increase of surface development of the electrode is obtained which surpasses the one obtainable by identical treatments of an electrode substantially consisting of a single grade of metal.

The thus prepared electrode is then film-formed and cut into the desired shape, and then either stacked or rolled together with one or more separators, and a second electrode of any desired type, into the desired condenser element.

Now the operating electrolyte can be introduced and the condenser finished.

In general, it is immaterial for the invention which metals and grades thereof are applied. It is essential, however, that grades are used which substantially differ as to their resistivity against mechanical and/or chemical attacks.

It is furthermore immaterial for the principal invention in which way the composite body comprising two or more different grades of metal is obtained, and the invention is not limited to any exemplification given hereinbefore.

The metal to be used for the electrode is preferably film forming such as, e. g., aluminum and tantalum. At least the grade of metal having higher resistivity against the roughening or etching attacks should have some dielectric oxide-film forming quality.

The invention is not limited to any example or theory developed hereinbefore, but is to be derived in its broadest aspect from the appended claims.

What I claim is:

1. An electrode material, particularly suited to be roughened or etched, composed substantially of at least two different and uniformly distributed grades of aluminum.

2. An electrode material, particularly suited to be roughened or etched, composed substantially of at least two grades of aluminum which are uniformly distributed and substantially differ as to their degree of being attackable by mechanical treatment.

3. An electrode material, particularly suited to be roughened or etched, composed substantially of at least two grades of aluminum which are uniformly distributed and substantially differ as to their degree of being attackable by chemical treatment.

4. An electrode comprising a body having at least one etched exposed surface, particularly suited for electrolytic devices, such as condensers, characterized in that said body substantially consists of at least two uniformly distributed grades of aluminum differing as to their resistance against etching, and said surface substantially consists of that grade of aluminum which is of higher resistance against etching.

5. An electrode comprising a body having at least one etched exposed surface, particularly suited for electrolytic devices, such as condensers, characterized in that said body consists substantially of at least two uniformly distributed grades of aluminum which substantially differ as to purity, and said surface consists substantially of that grade of aluminum which is of higher purity.

6. An electrode comprising a body having at least one roughened or etched exposed surface, particularly suited for electrolytic devices, such as condensers, characterized in that said body substantially consists of at least two uniformly distributed grades of aluminum substantially differing as to their resistance against roughening or etching treatments, and said surface substantially forms a type of net resulting from the removal to a substantial extent of the aluminum of lower resistance against said treatments.

7. An electrolytic device, such as condenser, comprising at least one electrode consisting of a body having at least one roughened or etched exposed surface provided with a dielectric film, characterized in that said body substantially consists of at least two uniformly distributed grades of aluminum substantially differing as to their resistance against roughening or etching treatments, and said surface substantially forms a type of net resulting from the removal by at least one of said treatments of the aluminum of lower resistance against such treatment.

8. An electrode material, particularly suited to be roughened or etched, consisting substantially of at least two grades of aluminum being uniformly distributed and differ substantially as to purity, as exemplified by one grade of 99.80% and another grade of 99.99% purity.

9. An electrode material, particularly suited to be roughened or etched, consisting substantially of at least two grades of aluminum being uniformly distributed and differ substantially as to purity, as exemplified by one grade of 99.80% and another grade of 99.99% purity, said different grades being present in a ratio of about 2:1 to about 1:2.

10. A roughened or etched electrode, particularly suited for electrolytic devices, such as condensers, having a body consisting substantially of a mixture of particles of at least two different and uniformly distributed grades of aluminum consolidated by heat treatment below melting temperature, and at least one roughened or etched exposed surface resulting from the removal of one of said grades of aluminum by roughening or etching.

11. A method of producing an electrode having an artificially enlarged surface, particularly suited for electrolytic devices, such as condensers, comprising the steps of plastifying and intimately mixing at least two grades of aluminum substantially differing as to their resistivity against etching treatments, shaping and solidifying the mixture so obtained and subjecting it to an etching treatment.

12. A method of producing an electrode having an artificially enlarged surface, particularly suited for electrolytic devices, such as condensers, comprising the steps of plastifying by heat treatment below their melting points and intimately mixing at least two grades of aluminum substantially differing as to their resistivity against etching treatments, shaping and solidifying the mixture so obtained and subjecting it to an etching treatment.

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