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METHOD OF ELECTROPLATING ALUMINUM AND ELECTROLYTE THEREFOR

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8 Claims. (Cl. 204—28)

This invention relates to an improved molten salt electrolyte and method for electrodeposition of aluminum.

The present application is a continuation-in-part of my earlier application Serial No. 481,265, filed January 11, 1955, now abandoned.

It is known that aluminum coatings can be plated electrolytically on certain base metals from anhydrous molten salt electrolytes which contain aluminum chloride and sodium chloride, and sometimes another metal such as lead. Anodes of high purity aluminum are immersed in the electrolyte, while the base metal becomes a cathode therein. Previously coatings deposited by such methods have not been altogether satisfactory. To produce a smooth surface on the plated product, it has been considered necessary to include lead in the electrolyte, yet lead is toxic and its presence precludes subsequent use of the product in food containers. Previous methods have been applied only to still plating; they do not produce a bright coating; and they require an uneconomically low current density of only about 15 amperes per square foot.

An object of my invention is to provide an improved electrolyte and method which overcome the foregoing disadvantages, that is, which furnish bright smooth coatings without the presence of toxic metals and are operable with higher current densities and on moving continuous lengths of base metal.

A further object is to provide an improved electrolyte incorporating an alkali metal fluoride, which I have found overcomes the disadvantages of previous electrolytes.

Electrolytes of my invention consist by weight of the following:

	Per cent
Aluminum chloride	60 to 90
Alkali metal chloride	9.5 to 39.5
Alkali metal fluoride	0.5 to 7

However, the best commercial ranges are somewhat narrower and consist by weight of the following:

	Per cent
Aluminum chloride	65 to 85
Alkali metal chloride	14.5 to 34.5
Alkali metal fluoride	0.5 to 4

According to the method of my invention anodes of high purity aluminum metal and a base metal cathode are immersed in a molten electrolyte of the foregoing composition. Examples of suitable base metals are steel or other ferrous metals, copper and brass. The temperature of the electrolyte is maintained between 400° and 900° F., but preferably between 450° and 650° F. A direct current of a density of 75 to 2500 amperes per square foot, but preferably 200 to 500 amperes, is applied between the anode and cathode. The base metal can be in the form of continuous steel strip, in which event the physical arrangement is similar to that used for electrolytic tinning; that is, the strip travels vertically between vertically disposed anodes on each side. The strip speed

can be between 400 and 1000 feet per minute, although tests conducted with rotating cathodes indicate speeds of 50 to 2500 feet per minute may be possible. A similar procedure can be used for plating aluminum on other products, such as copper wire.

The following are specific examples of electrolytes in accordance with my invention, the percentages again being by weight:

Example I

	Per cent
Aluminum chloride	80
Sodium chloride	18.5
Sodium fluoride	1.5

Example II

	Per cent
Aluminum chloride	80
Sodium chloride	18
Potassium fluoride	2

Example III

	Per cent
Aluminum chloride	75
Potassium chloride	23.5
Sodium fluoride	1.5

Example IV

	Per cent
Aluminum chloride	75
Potassium chloride	23
Potassium fluoride	2

In each example the electrolyte can be maintained at a temperature of about 550° F. Smooth bright coatings can be deposited on continuous lengths of such base metals as steel strip or copper wire having a surface speed of about 500 feet per minute with a current density of about 250 amperes per square foot.

While I have disclosed specific examples of the invention, it is apparent that reasonable equivalents are possible. Therefore I do not wish to be limited by the disclosure, but only by the scope of the appended claims.

I claim:

1. An anhydrous salt electrolyte for electrodeposition of aluminum said electrolyte being molten when heated to at least 400° F. and consisting by weight of the following:

	Per cent
Aluminum chloride	60 to 90
Alkali metal chloride	9.5 to 39.5
Alkali metal fluoride	0.5 to 7

2. An electrolyte as defined in claim 1 in which the chloride and fluoride salts are of an alkali metal of the group consisting of sodium and potassium.

3. An anhydrous salt electrolyte for electrodeposition of aluminum said electrolyte being molten when heated to at least 400° F. and consisting by weight of the following:

	Per cent
Aluminum chloride	65 to 85
Alkali metal chloride	14.5 to 34.5
Alkali metal fluoride	0.5 to 4

4. An electrolyte as defined in claim 3 in which the chloride and fluoride salts are of an alkali metal of the group consisting of sodium and potassium.

5. A method of electrolytically depositing aluminum coatings on a base metal of the group consisting of ferrous metals, copper and brass comprising immersing an aluminum anode and a base metal cathode in an anhy-

drous molten salt electrolyte consisting by weight of the following:

	Per cent
Aluminum chloride	60 to 90
Alkali metal chloride	9.5 to 39.5
Alkali metal fluoride	0.5 to 7

while maintaining the electrolyte temperature at 400° to 900° F. and the current density at 75 to 2500 amperes per square foot.

6. A method of electrolytically depositing aluminum coatings on a base metal of the group consisting of ferrous metals, copper and brass comprising immersing an aluminum anode and a base metal cathode in an anhydrous molten salt electrolyte consisting by weight of the following:

	Per cent
Aluminum chloride	65 to 85
Alkali metal chloride	14.5 to 34.5
Alkali metal fluoride	0.5 to 4

while maintaining the electrolyte temperature at 450° to 650° F. and the current density at 200 to 500 amperes per square foot.

7. A method as defined in claim 6 in which the chloride and fluoride salts are of an alkali metal of the group consisting of sodium and potassium.

8. A method of electrolytically depositing aluminum on continuous steel strip comprising passing the strip at speeds of 400 to 1000 feet per minute through an anhydrous molten salt electrolyte containing anodes of aluminum metal, said electrolyte consisting by weight of the following:

	Per cent
Aluminum chloride	60 to 90
Alkali metal chloride	9.5 to 39.5
Alkali metal fluoride	0.5 to 7

and maintaining the electrolyte temperature at 450° to 650° F. and a current density between the strip and the anodes of 200 to 500 amperes per square foot.

References Cited in the file of this patent

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