CONTEMPORARY METALLIC MATERIALS

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Chapter 033

Electrodeposition of Alloys

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Keywords: Alloy electrodeposition, Normal, Anomalous, Induced codeposition,

Abstract: The interest in alloy deposition increases not only for specific applications such as alloys of gold and of silver for electronics and of iron group metals with and without phosphorus for magnetic devices but also for superior properties not obtained by an individual metal deposition. It is well recognized that alloy electrodeposits may have desirable properties such as higher corrosion resistance, wear resistance, better electrical conductance and magnetic properties. Even though alloy deposition can be divided into five types, some people prefer divided into three, normal, anomalous and induced codeposition. The type of deposition is based on the composition metals in the deposit compared to that in the solution. For a normal type, composition of deposit is same to that of the solution while for anomalous, the metal that need more energy to be deposit is preferred. For the last type, the presence of iron group metal, a metal that cannot be deposit from aqueous state is deposited. The mechanism and the properties of these alloys are interesting.

Introduction

There is currently an upsurge of interest in alloy electrodeposition because the properties of these alloys can be exceptional and new applications have been reported [1]. The interest in alloy deposition increases for specific applications such as alloys of gold and of silver for electronics and of iron group metals with and without phosphorus for magnetic devices. In addition, superior properties not obtained by an individual metal deposition, makes alloy deposition more interesting. It is well recognized that alloy electrodeposits may have desirable properties such as higher corrosion resistance, wear resistance, better electrical conductance and magnetic properties. Alloys obtained by this method are true metallurgical alloys. They normally contain phases which are indicated by the phase diagram as stable for the temperature at which the electrodeposited alloy were formed, but sometimes high temperature phases form.

Types of alloy electrodeposition

In general the electrodeposited alloys can be categorized into five types [1] depending on the mode of formation:

- ✓ Regular codeposition
- ✓ Irregular codeposition
- ✓ Equilibrium codeposition
- ✓ Anomalous codeposition
- ✓ Induced codeposition

Chapter 034

Corrosion Behavior of Duplex Stainless Steel in Sea Water

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Keywords: Duplex stainless steel, corrosion, seawater

Abstract: Corrosion behavior of duplex stainless steel in seawater is interesting to discuss. The discussion includes corrosion rate, microstructure before and after corrosion test and corrosion potentials of duplex and austenitic stainless steels. The corrosion studies of austenitic stainless steel and duplex stainless steel in seawater have been carried out at room temperature for 78 days (1892 hours). In the exposure to seawater, duplex stainless steel was more corrosion resistance compare to austenitic stainless steel. From the weight loss and tafel extrapolation test, the corrosion rate of duplex stainless steel smaller than the austenitic stainless steel. These indicate that duplex stainless steel exhibits better corrosion resistance than austenitic stainless steel.

Introduction

Corrosion can occur in all types of metal at different temperatures. Corrosion can be described as a destructive result of chemical reaction between a metal or metal alloy and its environment. Corrosion can cause a variety of problems, depends on the applications such as:

- ✓ Perforation of tanks and pipes, which allows leakage of fluids or gases,
- ✓ Loss of strength where the cross section of structural members is reduced by corrosion, leading to a loss of strength of the structure and subsequent failure,
- ✓ Degradation of appearance, where corrosion products can detract from a decorative surface finish,
- ✓ Can produce scale or rust which can contaminate the material being handled; particularly in the case of food processing equipment.

Most materials corrode because they are used in environments where they are chemically unstable. Some major problems of corrosion are on buried oil and the gas transmission pipelines. Millions of dollars are lost each year because of corrosion. Much of this loss is due to the corrosion of iron and steel, although many other metals may corrode as well. The problem with iron as well as many other metals is that the oxide formed by oxidation does not firmly adhere to the surface of the metal and flakes off easily causing pitting corrosion [1].

Duplex Stainless Steels

Chapter 035

Cathodic Protection of Underground Pipes

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Keywords: Cathodic Protection, Underground Pipe, Corrosion Protection

Abstract: Corrosion in aqueous solutions is an electrochemical process where anodic and cathodic reactions occur simultaneously. No net overall charge builds up on the metal as a result of corrosion since the rate of the anodic and cathodic reactions are equal. If reactions anodic and cathodic occur simultaneously in a piece of metal, the rate of these two reactions can be altered by withdrawing electrons or supplying additional electrons to the piece of metal. It is an established principle that if a change occurs in one of the factors under which a system is in equilibrium, the system will tend to adjust itself so as to eliminate, as far as possible, the effect of that change. Thus, if we withdraw electrons from the piece of metal the rate of anodic reaction will increase and the dissolution of metal will increase, whereas reduction reaction will decrease. Conversely, if we supply additional electrons from an external source to the piece of metal, anodic reaction will decrease to give reduced corrosion and cathodic reaction will increase. The latter case will apply to cathodic protection. Thus, to prevent corrosion, continue supplying electrons to the metal from an external source is needed to satisfy the requirements of the cathodic reaction. Cathodic protection may be achieved in either by the use of an impressed current from an electrical source, or by the use of sacrificial anodes. Generally, sacrificial anode schemes have found favour for small well-coated low-current demand structures or for localised protection, while impressed-current schemes being utilized for large complex structures which may be bare or poorly coated.

Introduction

Development of cathodic protection systems was made in to meet the requirements of oil and natural gas industry which wanted to benefit from the advantages of using thin-walled steel pipes for underground transmission. Cathodic protection can, in principle, be applied to any metallic structure in contact with a bulk electrolyte. In practice, its main use is to protect steel structures buried in soil or immersed in water. It cannot be used to prevent atmospheric corrosion.

Structures commonly protected are the exterior surfaces of pipelines, ships' hulls, jetties, foundation piling, and offshore platforms. Cathodic protection is also used on the interior surfaces of water-storage tanks and water-circulating systems. However, since an external anode will seldom spread the protection for a distance of more than two or three pipe-diameters, the method is not suitable for the protection of small-bore pipework.

Chapter 001

Upgrading of Laterite Ore by Reduction and Leaching

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Keywords: Magnetization, Limonitic ore, Leaching, Nickel, Ironmaking.

Abstract: In the viewpoint of environment preservation and efficient utilization of resources, a series process has been developed to utilize limonitic ore. Limonite is mineral content in laterite sediment with low Ni content and nickel laterite mining waste that can be an alternative raw material of iron making due to its high iron content. Upgrading of the ore was started with magnetization using mixed carbon monoxide and carbon dioxide gases at desired temperature then followed by leaching of the magnetized sample in sulphuric acid media. The result indicated that magnetization can speed up the nickel dissolution and obstruct the iron dissolution. The dissolution rate of nickel was very high in the period of less than 5 min for magnetized sample. The nickel dissolution would be higher by prolonging the leaching time. However, leaching time would not increase the dissolution of both nickel and iron in the non-magnetized sample. Accordingly, magnetization of the ore can control the non metallic dissolution in the leaching process such as iron oxide. At the end of the leaching process, there will be iron-rich residue with minimal nickel content and nickel-rich solution.

Introduction

Laterite ore is one of the mineral resources containing several kinds of metal elements, such as nickel, cobalt and iron. It is widely distributed in the equatorial region, such as India, Philippine and Indonesia, and is mainly used as a nickel resource. However, the utilization is limited to only the high grade nickel content. Over three decades of nickel refining operation, mining has centered predominantly on nickel containing ore to be fed to ferronickel smelter or nickel matte process. As a proven deposit, the top layer of nickel ore with high content of iron, those containing significant limonitic ore have been reviewed its possibility to be utilized in production of iron ore pellet as well as nickel containing pig iron [1,2]. Although the fundamental characteristics of lateritic ore have been reported in several literatures [3,4], further research on the mineralogical characteristics and reduction behavior of the ore is essential for further utilization as iron ore. When the high-grade Fe laterite is used for iron and steel industries, the complicated chemical structure brings about some difficulties. The high amounts of nickel and cobalt contents result in the low quality of the pig iron produced. Therefore, it is necessary to eliminate the nickel to get a useful laterite for iron-making.

Several methods have been reported to extract Ni using leaching by sulphuric acid, hydrochloric leaching or nitric acid, sulphating process, and so on [5-7]. One of the methods commercially applied is the direct pressure leaching using sulphuric acid (Moa Bay method)

Upgrading of Laterite Ore by Reduction and Leaching

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