INTRODUCTION

Introduction

Tin metal is silver white, soft, ductile, nontoxic, lubricity, with excellent corrosion resistance in air, and able to form many useful alloys (1). With its low melting point, 232°C, and high boiling point, 2270°C, tin has a liquid range exceeded by just few metals. It readily alloys with many metals to form several intermetallic compounds of commercial importance. Copper, nickel, silver, gold, and palladium are soluble in liquid tin. Molten tin wets and adheres readily to clean iron, steel, copper, and copper-base alloys.

There are two allotropic forms of tin: white (β) and gray (α). White or ordinary tin, the familiar form, crystallizes in the body-centered tetragonal system, and possesses properties that make it useful. Gray tin has a diamond lattice, it is considerably less dense than β-tin and has a nonmetallic appearance and properties. Gray tin has also semiconductor properties. The allotropic transformation between the two forms occurs at 13°C and is extremely slow. The allotropic change is known as "tin pest", probably because it appears to spread from the center of "infection". The transformation is inhibited or prevented by the incorporation of few tenths of percent of antimony, lead or bismuth into the tin. The atomic number of tin is 50 while its atomic weight is 118.69. Due to its electronic configuration, $4d^{10}\ 5s^2\ 5p^2$, tin has four electrons available for bonding. Accordingly, tin is tetravalent in many of its compounds; as with its homologies germanium and lead. However, the 5s electrons may act as inert pair, consequently tin is also divalent. In this respect tin is intermediate between germanium and lead; with the former, bivalency is uncommon and lead exhibits tetra-valency only in its organic compounds. For tin, the two valence states are almost equally stable and readily inter-convertible. Solutions of stannic tin, Sn (IV), are readily reduced to stannous tin, Sn (II), by many reducing agents, especially metals such as antimony and nickel. On the other hand, solutions of Sn (II) are just as readily oxidized to Sn (IV) by common oxidants including air.

Tin is amphoteric, it reacts with acids and bases while relatively resistant to neutral solutions. The over potential of hydrogen evolution on tin is quite high, about 0.75V, so that the attack by acids and bases is slow unless in the presence of an oxidizing agent to depolarize the evolution of hydrogen. Distilled water has no effect on tin, and so it is the preferred medium for preparing and storing it.

In acidic solutions, Sn (II) compounds probably exist in the form of Sn^{2+} aqua ion, but Sn (IV) probably does not exist as such. It is either hydrolyzed or complexed as in $[SnCl_6]^{2-}$ and $[Sn\,(OH)_6]^{2-}$. In alkaline media, Sn (IV) is the most stable; alkaline stannite, or stannate (II) solutions disproportionate according to:

$$2[Sn\,(OH)_4]^{2-} \rightarrow [Sn\,(OH)_6]^{2-} + Sn + 2(OH)^-$$

This reaction is important in plating from alkaline stannate solutions. All tin compounds tend to hydrolyze in aqueous solutions. Alkaline solutions must be stabilized by the presence of excess alkali, acid solutions of excess acid.

Uses of Tin

Tin has attracted considerable attention during the past several decades because of its desirable physical properties such as high