CONTEMPORARY METALLIC MATERIALS

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Chapter 009

Alloy Coating on Steel Surfaces by Melt Synthesis of Elemental Metal Powders

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Keyword: Metal powder, TIG torch, Nickel-Chromium coating, Microstructure, Melt depth

Abstract: An alloy layer of Ni-Cr was processed by synthesis of preplaced 80wt% Ni and 20wt% Cr powder on AISI 4340 substrate surfaces and melting under Tungsten Inert Gas (TIG) torch with different heat inputs, controlled by changing current and traverse speed. The effects of amount of powder preplacement (mg/mm^2) and heat input on resolidified melt pool size, microstructure and hardness were investigated. Resolidified melt microstructure consisted of Fe-Ni-Cr alloy with cell type dendritic structure along with a thick martensite heat affected zone. They were found in all processing conditions. Hardness of the melt zone increased with the increase of melting power and reduced powder addition indicating more dilution of the base metal. Dimensions of melt and heat affected zones increased with increasing the heat input for melting operation.

Introduction

Metallic parts are prone to lose their accuracy stability because of the wear and corrosion thus making the application of that utilized component to progressively fail. Such parts are coated with a protective layer especially when used in aggressive environments. Many works have been conducted to identify coating materials and deposition techniques so that the shelf life of the bulk material could be prolonged and protected against these failures. Electrochemical deposition of nickel or chromium and galvanization are widely used to protect plain carbon steels against atmospheric corrosion.

A wide range of Fe-Cr-Ni alloys that are based on the FCC γ-phase according to the phase diagram in Figure 9.1 are suitable for applications in corrosions environments. These alloys are characterized by their good combinations of corrosion resistance and mechanical strength at elevated temperature. In general, there are two groups of alloys: Inconels based on the composition Ni–16Cr–7Fe (IN600) and Incoloys (IN800 family) with the basic composition Ni–20Cr–48Fe. The latter are typically used in scenarios in which hot corrosion resistance is required. In general, the high iron content increases the solubility of interstitials, thereby reducing the possibility of forming embrittling carbides. In the case of the first group of alloys, the strengths are retained up to 600°C. Increased strength can also be achieved by increased Cr and alloying with Mo and Nb in solid solution. This results in increased elevated-temperature strength and improved ductility.