Corrosion Behaviors of Additively Manufactured Stainless Steel Coated with Epoxy

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Abstract

In this study, the corrosion behavior of additively manufactured (AM'd) or 3D printed 316L stainless steel (SS) coated with an epoxy coating was studied. Four types of samples were used, 3D printed stainless steel with coating, 3D printed without coating, conventional with coating, and conventional without coating. The corrosion behaviors of the samples were measured. It shows that the epoxy coating layer significantly improved the samples' corrosion resistance.

1 Introduction

316L stainless steel (SS) has been used for structural applications, It mainly consists of alloying elements of Cr, Ni, and Mo, and Fe has a face-centered cubic (fcc) structure of austenite. The austenitic stainless steels are prone to localized corrosion in long-term usage[1]. Epoxy coatings have been extensively used on steels for protecting them in corrosive environments. It plays as a physical barrier to isolate metal substrates from water, dissolved oxygen, and corrosive ions[2]. Recently, additive manufacturing (AM) has emerged as a promising fabrication technique, which provides opportunities for manufacturing complex and net-shape parts based on 3D models [3, 4]. However, there is limited research conducted on the coatings on the additively manufactured (AM'd) stainless steels.

In this work, the objective is to understand the electrochemical properties of AM'd 316L stainless steel. Both epoxy coated and uncoated stainless steels fabricated from AM process and wrought counterpart are considered. Additionally, to explore the interfacial properties, the bond strength was tested on the interface between the coating layer and the 316L SS samples, and the corrosion properties were also explored.