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Corrosion behavior of metallic alloys obtained by additive manufacturing

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Among the alloys, the most used in additive manufacturing (AM) technologies are surely Co-Cr, Ti-, Al- and Ni-alloys. Such alloys cover the most widespread industrial applications form automotive/aerospace, to medical, energy and oil & gas. The material qualification process of the alloys in the specific environment is nowadays gaining lot of importance, as the corrosion behavior of traditional casting and wrought alloys is well known, but it significantly modifies due to macro and microstructure modifications induced by additive manufacturing process. The results of several reserches emphasize strict correlation between the corrosion behavior and the unique microstructure of these alloys, thus giving rise to new opportunities for increasing the knowlwge in corrosion science. Corrosion mechanisms are also affected by both the production processes and heat treatments. Additive technologies have several and undubtful advantages compared to subtractive ones, mainly due to the possibility to produce components with very complex and non-dense geometries (micro and macro porous, trabecular, etc.). The unique microstructure, the widening of the solubility field of the alloy elements due to rapid cooling, the precipitation of non-equilibrium phases, the different surface conditions and heat treatments are only some of the elements affecting both the mechanical behaviour and the corrosion resistance. In fact, for applications in particularly aggressive environments, the qualification of these materials must be completely re-discussed, as well as the definition of new production standards and post-processing heat treatments specifically designed to enhance their peculiarities.

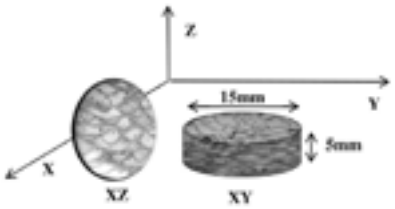

Figure 1: Schematic representation of the microstrucutre of the alloy AlSi10Mg obtained by means laser powder bed fusion as a function of the directions of the production

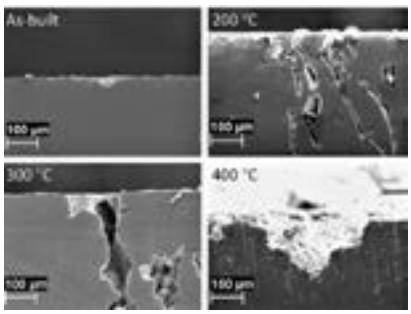

Figure 2: effect of the temperature of post processing heat treatments on the corrosion behavior of the AlSi10Mg alloy

Recent Publications:

1. Cabrini Marina, Lorenzi Sergio and Pastore Tommaso (2018) Effects of thiosulphates and sulphite ions on steel corrosion. Corrosion Science 135:158-166.
2. Cabrini Marina, Calignano Flaviana, Fino Paolo, Lorenzi Sergio, Lorusso Massimo, Manfredi Diego, Testa Cristian and Pastore Tommaso (2018) Corrosion behavior of heat-treated AlSi10Mg manufactured by laser powder bed fusion. Materials 11:1-14.
3. Cabrini Marina, Lorenzi Sergio, Pastore Tommaso, Testa Cristian, Manfredi Diego, Cattano Giulio and Calignano Flaviana (2018) Corrosion resistance in chloride solution of the AlSi10Mg alloy obtained by means of LPBF. Surface and Interface Analysis 1-6.

4. Cabrini M, Lorenzi S, Pastore T, Pesenti Bucella D, Pellegrini G, Paggi A, Paravicini Bagliani E and Darcis P (2018) Development of new tests to assess sulfide stress corrosion cracking of line pipes. La Metallurgia Italiana 110:11-21.

5. Cabrini Marina, Lorenzi Sergio, Pastore Tommaso and Pesenti Bucella Diego (2018) Effect of hot mill scale on hydrogen embrittlement of high strength steels for pre-stressed concrete structures. Metals 8:1-12

Biography

Marina Cabrini is an Associate Professor of metallic materials, polymer, composites and ceramics, and biomaterials at the University of Bergamo and of PhD course in Electrochemistry and Electrochemical Technologies. She is an Italian delegate in the Board of International Corrosion Council (ICC), member of European Federation of Corrosion and International Electrochemical Society. Her research activity is on electrochemistry and corrosion, primary focused on the environmental assisted cracking of traditional and innovative alloys, biomaterials, and corrosion of alloys produced by means of additive manufacturing. She has published more than 40 papers in reputed journals and has been serving as Review and Editorial Board Member of repute journals.

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