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Metallic Additive Manufacturing

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Abstract: ***As metallic additive manufacturing grew in many areas, many users have requested greater control over the systems, namely the ability to change the process parameters. The goal of this paper is to review the effects of major process parameters on the quality such as porosity, residual stress, and composition changes and materials properties like microstructure and microsegregation.***
In this article, we give an overview over the different kinds of metals specially steels in additive manufacturing processes and present their microstructures, their mechanical and corrosion properties, and their heat treatments and their application. Our aim is to detect the microstructures as well as the mechanical and electrochemical properties of metals specially the steels. Steels are subjected during additive manufacturing processing to time-temperature profiles which are very different from the conventional process. We do not describe in detail the additive manufacturing process parameters required to achieve dense parts. We discuss the impact of process parameters on the microstructure, where necessary.

I. INTRODUCTION

The main advantages of additive manufacturing (AM) technologies of metallic parts compared to conventionals and shaping processes are to produce complex parts with a minimum time, minimum cost and with low energy consumption. AM technologies has wide scope within the defense, energy, aerospace, and biomedical industries .Today the applications of additive manufacturing appear to almost be limitless. It is used to fabricate high-tech industrial , consumer products and progress in polymeric materials for the manufacturing industry.
In additive manufacturing layers of material are formed under the computer control to create an object. Additive manufacturing has many advantages in production of parts with the ability to manufacture single or multiple components from various range of materials. Additive Manufacturing ,also referred to as 3D Printing. It is a technology that produces three dimensional parts layer by layer from material, or it may be polymer or metal based. Additive manufacturing ,as its name implies,it adds material to create an object. But when you creat an object by traditional technique ,it is necessary to remove material by using various machining process like milling, shaping. While additive manufacturing delivers a perfect trifecta of imporved performance, complex geometries and simplified fabrication.

II. PROBLEMS STATEMENT:

In this paper we aim to fill that gap by providing a review of the many different metals in additive manufacturing. Our focus is on the microstructures as well as the mechanical and electrochemical properties of various types of metals used additive manufacturing. We intentionally do not describe metal matrix composites (MMC) here. As there are infinite possibilities for part design, it is not possible to have one parameter set that will be fully optimized for all part features like thin walls, thick sections, overhangs, material performance and process. We identify areas with missing information in the literature and assess which properties of additive manufacturing. We close our review with a short summary of functional properties and their application perspectives in Additive Manufacturing.

III. EFFECT OF ADDITIVE MANUFACTURING PROCESSING PARAMETERS ON MATERIALS

Metallic additive manufacturing techniques is based on rapid solidification. When we remove the source of energy cooling rates goes upto $105 – 106\ K \cdot s^{-1}$. In small grain size particles, due to the rapid solidification metastable phases are formed . Due to the large energy is required in the AM process the material vaporization temperature is reached maximum in AM techniques. Due to this evaporative losses are occurs and they are closely related to the maximum temperature reached, and the temperature dependent vapor pressures of the constitutive elements. When we require the material which has a good resistance to environmentally harsh condition then we go for stainless steels. These types of steels are used in large variety of applications where the parts are in contact with corrosive media.

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Types of Steel and their applications:

A. Austenitic Stainless steels in AM

Auatenitic stainless steel is one of the important type of steel .Its primary crystalline structure is austenite and it prevents steel from being hardenable by heat treatment and make the steel non magnetic. It has excellent corrosion resistance, and ductility. In these steels, the high chromium content (17- 18 wt.-%) leads to a good corrosion resistance, while the nickel additions keep the microstructure of the alloys fully austenitic in conventionallyproduced materials. Fatigue strength stainless steel samples is an important factor for applications in areas such as the medical or aerospace industry .

B. Martensitic Stainless Steels

We can easily obtain fully dense specimens with fully martensitic microstructures both by DED and by L-PBF.
There are two types of tool steels in additive manufacturing , namely carbon-free maraging steels and carbon-bearing tool steels. In both types of tool steel, the final microstructure consists of martensite . In case of carbon-bearing tool steels, the martensitic matrix without precipitates obtained upon quenching is hard and brittle . In case of the high-Ni maraging steels, due to quenching it gives comparably soft and ductile martensitic microstructure.

IV. CONCLUSION & FUTURE SCOPE

A. Conclusion

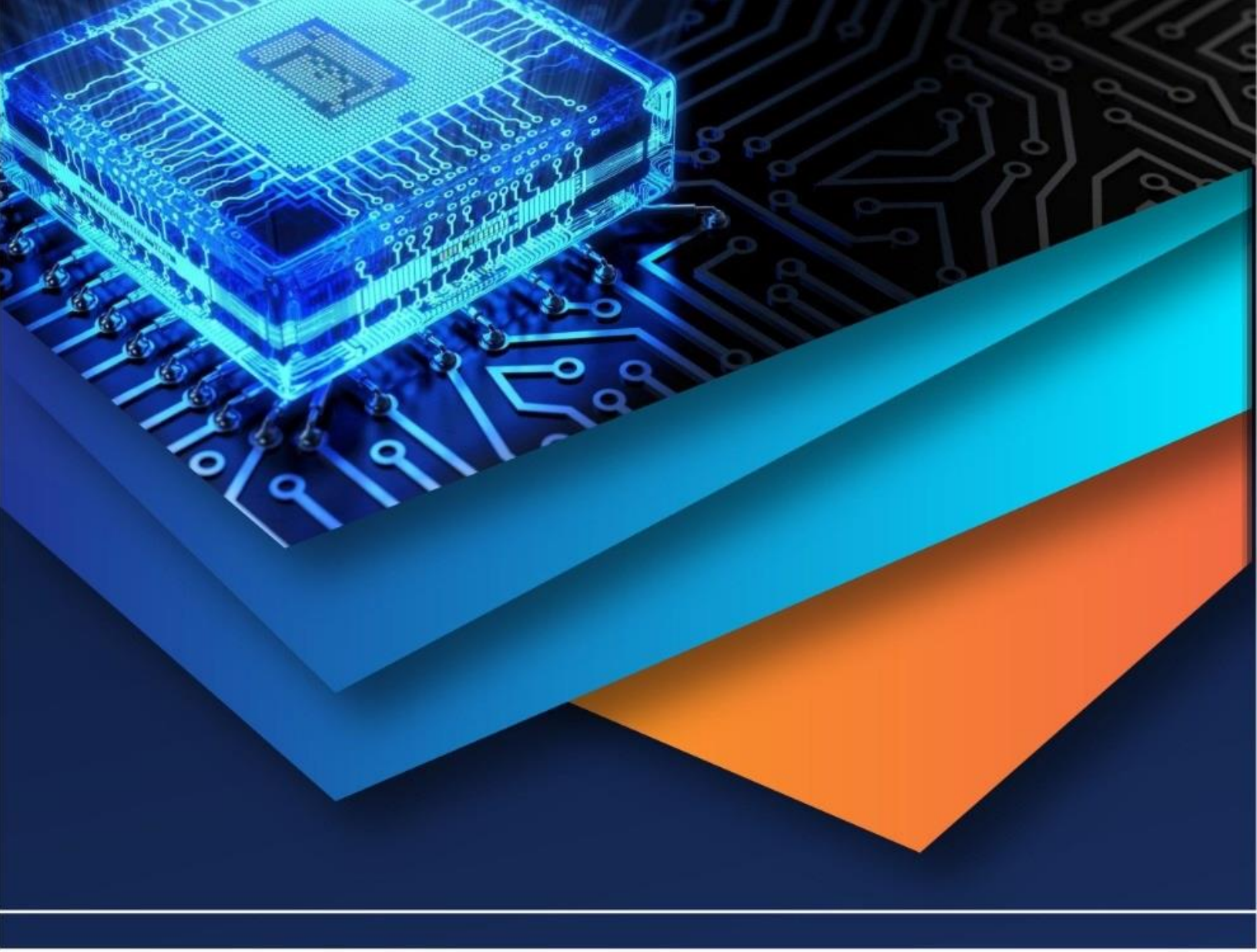
Steels are the useful most, important, affordable and available structural materials now a days .It is used in many industry like transportation, energy conversion, safety, health, infrastructure and manufacturing. The corrosion properties of steels mainly stainless steel ,produced by additive manufacturing process are better than the material produced by conventionally.

B. Future Scope

In the future, additional research is required to overcome the challenges in additive manufacturing processing.
The many research being conducted on additive manufacturing of metals especially on the steels up to now is about the processing of existing alloys with new processes.. There is, increasing interest in utilizing the additive manufacturing for making parts of iron base alloys with many of the functional properties. Further iron-based materials that are considered for use in additive manufacturing include amorphous, nanocrystalline, and magnetocaloric materials.

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