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Posters

Environmental behaviour of Ti-6Al-4V alloy obtained by additive manufacturing technology

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The attractiveness of additive manufacturing (AM) technology relates to its capability to produce complex components with reduced weight at a relatively short time. The advantage of AM technology and selective laser melting (SLM) process in particular mainly relates to its ability to produce components layer-by-layer using high energy laser and selective fusing process of metallic powder bed. Although Titanium base alloys are considered as favourable material for SLM process, the significantly increased solidification rate associate with this technology results in producing modified microstructure with increased internal stresses that can have a detrimental effect on corrosion performance.

The present study aims at evaluating the environmental behaviour of Ti-6Al-4V alloy produced by SLM in compression with its counterpart wrought alloy with the same chemical composition. Corrosion behaviour measurements in terms of immersion test, cyclic potentiodynamic polarization analysis, impedance spectroscopy (EIS) and stress corrosion by slow strain rate testing (SSRT) were carried out in 3.5%NaCl solution at ambient temperature. The microstructure and internal stresses were evaluated by Scanning Electron Microscopy (SEM) and X-ray diffraction analysis.

The results obtained clearly revealed that the corrosion resistance as well as the stress corrosion endurance in terms of time to failure of the SLM alloy was relatively reduced compared to its counterpart wrought alloy. This was mainly related to the increased formation of α'-phase with martensitic structure and due to the relatively reduced amount of βphase.

Speaker Biography

A Leon is PhD student in materials science and engineering faculty at Ben Gurion University of the Negev in Israel. Since 2014 his main research work is on the environmental behaviour and properties of light alloys produced by Additive Manufacturing (AM). Moreover, his research interest includes developing of new biodegradable alloys.

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Evaluation of compressive and flexural properties of a fiber reinforced additive manufacturing technology as a design input for a novel foot-ankle device

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This research focused on the characterization of additive manufacturing technology based on composite filament fabrication (CFF) as a design input for a novel foot-ankle device. CFF utilizes a similar method of layer by layer printing as fused filament fabrication, but is also capable of reinforcing parts with layers of various continuous fibers into a polymer matrix. Due to the orthotropic characteristics of additive manufacturing based on fused filament fabrication, 3D printed parts may present different mechanical behaviour under different orientations of stress. Furthermore, technologies such as CFF allow a range of configurations to fabricate and reinforce the parts. In this study, mechanical characterization of polyamide 6 (PA6) reinforced with carbon fiber and fiberglass was conducted by design of experiment as a statistical method, to investigate the effect of reinforcement, print orientation and percentage of fiber on mechanical properties in compression and flexion. The results were considered as an input to design and validate a novel low-cost foot-ankle device by using CAD and CAE tools.

Speaker Biography

Miguel Araya-Calvo is currently working on a Master's degree thesis in Medical Device Engineering from the Instituto Tecnológico de Costa Rica, Costa Rica, related with a novel foot-ankle design implementing fiber-reinforced additive manufacturing technology. He is a researcher at the ergonomics and biomechanics laboratory and an Industrial Design Engineering professor at Instituto Tecnológico de Costa Rica. He has focused for more than 3 years on the implementation of 3D printing for low cost below-the-knee prosthetic solutions.

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Accepted Abstracts

3D printing for bioresorbable medical devices

Scott Taylor
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3D printed devices are enabled through advanced equipment and materials, though there are hurdles maximizing this technology. Application of materials specifically suited for medical device manufacturing is key. Poly-Med CTO, Scott Taylor, will explain that while PLA, a bioresorbable polymer, is available for 3D printing, medical-specific quality requirements are often not in place and mechanics aren't appropriate for most products. Poly-Med supports development and manufacturing of bioresorbable products from a wide variety of implantgrade 3D printing materials, including Max-Prene®, Dioxaprene®, and Lactoprene® filaments. Our engineers support conversion of medical products from permanent to bioresorbable, prototype through manufacturing, with full analytical support.

3D printing: coming of age and transforming your business

Richard Garrity
Stratasys, USA

Come and learn how 3D printing has been driving true change across industries by improving product innovation and time to market, streamlining traditional manufacturing processes and reducing costs. And while the technology plays a strategic role in many of the world's leading manufacturers, customers are now taking the next step into Industry 4.0 - aligning additive manufacturing with the factory floor.This transformation is real, with analysts estimating an economic impact of $230 - $550 billion per year by 2025 across consumer products, direct product manufacturing and tooling/mold manufacturing. By attending this session, attendees will discover new opportunities for growth and leadership – understanding how 3D printing is transforming business models by creating unprecedented operational efficiency and accelerating time-to-market. We'll investigate companies around the world who are transforming their business models with supply chain efficiencies, product customization and digitization of their production lines. Looking ahead, the audience will understand the way 3D printing is coming of age and reinventing the value chain – empowering organizations to be more competitive and solidify market leadership in this evolving business environment.

Additive manufacturing of near-net-shape NdFeB magnets – prospects and challenges

M. Parans Paranthaman
Oak Ridge National Laboratory, USA

The main goal of this research is to minimize the critical materials waste associated with NdFeB based permanent magnet manufacturing and reduce the overall cost. One of the ways in which we can achieve this goal is by using additive manufacturing techniques to create different shapes and complex geometries of bonded magnets without the need for tooling. We have recently demonstrated the fabrication of near-net shape magnets with complex geometries and high energy product using > 65 vol % MQP NdFeB nylon composites using Big Area Additive Manufacturing System. We will report in detail about the relationship between the processing, microstructure and property of additively printed bonded magnets.

Technical and clinical considerations for the development of 3D printed upper-limb prostheses for children

Jorge M Zuniga
University of Nebraska at Omaha, USA

Advancements in computer-aided design (CAD) programs and additive manufacturing (3D printing) offer the possibility of designing and printing customized upper-limb prostheses at a low cost. However, there is a lack of specific technical descriptions and clinical evidence supporting the use of 3D printed prostheses. The purpose of this investigation was to provide technical considerations and clinical evidence of the possible benefits and obstacles in the use of upper-limb 3D printed prostheses in pediatric populations. This information is crucial for clinicians interested in exploring the use of 3D printed prostheses for their patients.

Overview of 3D printing application in construction: Analysis and recommendations

Zoubeir LAFHAJ
Lille University of Science and Technology, France

Currently in civil engineering, competition no longer concerns the national sphere but is played at the global level. It is therefore necessary to rethink the construction process in order to make it as efficient as possible at the productivity, environmental the socio-economic levels. 3D Printing in Construction is gaining popularity thanks to the extensive research made and the raising interest by construction professionals in innovation. The presentation gives an overview of the latest advancements made in 3D printing in Construction (Figure 1 reveals the main 3D Printing institutions and technologies that will be developed during the presentation) and the future trends and perspectives (what we will expect from 3D Printing in the near and long terms). Based on this state of the art, some commons elements emerges. The most critical one concern the materials used for 3D Printing in Construction

Figure 1. 3D Printing in Construction map

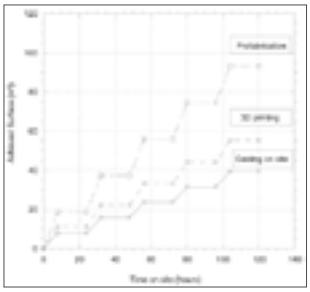

Figure 2. Evolution of achieved surface according to time on site for prefabrication, Casting on site and 3D Printing.

Product optimization with additive manufacturing - from aerospace to everyday applications

Thomas Reiher
Paderborn University, Germany

Additive Manufacturing (AM) is a promising technology and has advanced over the last years in terms of cost- and product optimization potential. The advantages of AM have been identified already in early stages from the aerospace and space industry. Here a strong interest in lightweight design is explained by financial revenues resulting from low buy-to-fly ratios and decreased part weight. Hence, these branches may allocate large budgets for technology development. Based on this motivation, fundamental work on the design of very complex lightweight load and stress optimized structural elements e.g. for satellites have been performed. The result is a methodology for an easy to use and cost efficient topology optimization-process, which will be presented in the speech. Based on this methodology not only aero-/space parts are discussed, but also industrial applications (e.g. from machine tools). The speech will show the transfer from results in the aerospace sector into everyday industrial applications. With regards to the cost development, AM will soon be seen not only in space but in earthbound machines at the shop floor.

3D printing contribution for sustainable development

Nuno Lopes
United Nations University, Portugal

The world urban population will grow around 63% between 2014 and 2050. Megacities, that is, cities with over 20 million inhabitants, will increase from the actual 28 to 41 by 2030. Today, cities are already facing severe challenges in order to become sustainable in the long run, but in the future, with the foreseen urbanization rate, the sustainability challenges will be even greater. For becoming sustainable cities, technology-enabled solutions can be used for improving cities mobility, energy consumption, environment, economy, quality of life, education, public services, governance, and decision-making processes. 3D printing, as an emerging and disruptive technology, can significantly contribute to achieve the sustainability and environmental goals of the United Nations Agenda 2030. This presentation helps to get a clearer understanding of how 3D printing can help deliver better public services, interact with citizens, reduce costs, waste and environmental impact, improve efficiency, and help humanity by producing human organs, food and fashion products. In this talk, several case studies on 3D printing initiatives will be presented, which are being implemented around the world in order to achieve sustainable cities and communities.