Status and prospect of Al alloys for additive manufacturing

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Additive Manufacturing technology is being adopted in more and more industries and the focus of research and development is shifting to the materials in use. However, limited processability of high-performance Al alloys restrict the robustness of the process in some cases, while in other cases the best Al alloys for a given application cannot be processed at all. Currently only a few alloys can be reliably processed by this methodology, and in particular the number of different aluminium alloys available for AM is still rather limited. The main reason is that the strongest Al alloys, which get their strength from precipitation hardening, contain highly volatile elements such as Zn, Mg, etc. leading to turbulent pools, pores and low mechanical properties. In the first part, this talk will review the current state of the art of the Al alloys for AM. In the second part, the latest research on development of the innovative aluminium alloy specifically designed for SLM will be described. Two different approaches will be presented: on one hand, on tailoring the chemical composition to improve processability, specifically crack susceptibility of wrought aluminium alloys of the 7xxx series (Al-Zn alloys) and on the other, to increase mechanical resistance of weldable casting grade AlSi10Mg alloy. It will be demonstrted that both approaches yielde the new alloys processable by SLM with properties equal or even better than the standard Al7075 alloy which is the workhorse of aerospace industry.

Recent Publications:

1. Martín A, San Sebastián M, Gil E, Wang CY, Milenkovic S, Pérez-Prado MT, Cepeda-Jiménez CM (2021) Influence of the Zr content on the processability of a high strength Al-Zn-Mg-Cu-Zr alloy by laser powder bed fusion. Materials Characterization, 182: 11513
2. Martín A., San Sebastián M., Gil E., Wang C.Y., Milenkovic S., Pérez-Prado M.T., Cepeda-Jiménez C.M., (2021) Effect of the heat treatment on the microstructure and hardness evolution of an AlSi10MgCu alloy designed for laser powder bed fusion. Materials Science and Engineering A, 819 141487 (1-12).
3. Galera-Rueda C, Montero-Sistiaga M, Vanmeensel K, Godino-Martínez M, Llorca J, Pérez-Prado MT, Milenkovic S. (2021) Icosahedral quasicrystal enhanced nucleation in Al alloys fabricated by selective laser melting. Additive Manufacturing, 44: 102053.
4. Galera-Rueda C, Nieto-Valeiras E, Gardon M. Pérez-Prado MT, Llorca J (2021) Effect of ZrH2 particles on the microstructure and mechanical properties of IN718 manufactured by selective laser melting. Materials Science and Engineering A, 813: 1-11.

5. Requena G, Bugelnig K, Sket F, Milenkovic S, Roedler G, Weisheit A, Gussone J, Haubrich J, Barriobero-Vila P, Pusztai T, Gránásy L, Theofilatos A, Da Silva JC, Hecht U (2020) Ultrafine Fe-Fe2Ti eutectics by directed energy deposition: Insights into microstructure formation based on experimental techniques and phase field modelling, Additive Manufacturing, 33: 101133.

Biography

Srdjan Milenkovic obtained a PhD in 2002 from the State University of Campinas, Brazil Dr, Srdjan Milenkovic joined the department of Materials Technology at the Max-Planck-Institute for Iron Research (MPIE) in Düsseldorf, Germany, as a research associate. Since March 2011, appointed as a head of the Solidification Processing and Engineering group at the IMDEA Materials Institute. His research expertise includes advanced solidification processing techniques with special emphasis on alloy development for additive manufacturing and gas atomization of powders. Publication record: published over 60 papers in JCR journals, among which two in Nano Letters with impact factor >10.