INFLUENCE OF HYDROGEN, OXYGEN, AND NITROGEN ON MATERIAL PROPERTIES

This project answers the question of the extent to which the inert gases used in the additive manufacturing process, as well as the gases introduced by the manufactured material, affect the material properties. Particular attention is devoted to the influence of hydrogen, oxygen and nitrogen.

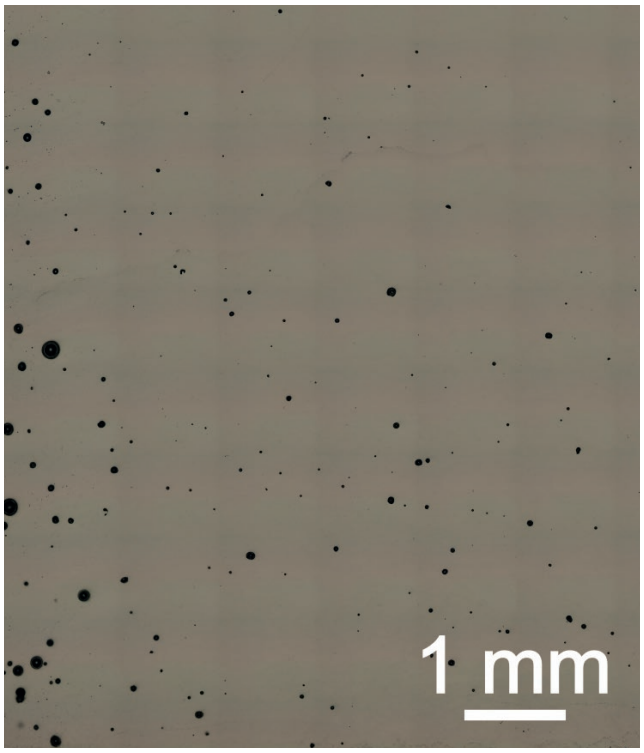

FIGURE 1: Additive manufactured sample made of AlSi10Mg with pores caused by gases

During the laser beam melting of metals (LBM), the used inert gases prevent chemical reactions (oxidation) with the molten material and can also have an effect on the material properties. If nitrogen is used in LBM, nitrides can form. Furthermore, residual oxygen can be caused by insufficient displacement of the atmosphere in the build chamber or by processing porous powder particles. When using undried powder, moisture can lead to hydrogen-infused pores. With increasing duration of powder usage, the drying of the powder may become increasingly elaborate, and the risk of absorbing oxygen or nitrogen during the previous process conditions exists.

Objective

The content of hydrogen (H), oxygen (O), and nitrogen (N) in powder, which has been used several times for the additive manufacturing process, is to be determined after defined cycles of use. Likewise, test specimens will be produced and characterized with repeatedly used powder and the influence of H, O, and N on material properties will be identified.

Project Scope

The H, O, and N absorption in both powder and additive manufactured samples, will be determined after a defined number of cycles by using carrier gas hot extraction analysis and wavelength dispersive x-ray spectroscopy. Heat treatment is applied and the effect on the reducing of H, N, and O portion is investigated. The achievable density as well as mechanical properties for quasi-static and dynamic loading, are ascertained taking the H, N, and O content into account.

PROJECT OVERVIEW

DURATION	03/2022 – 12/2022
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FUNDED BY	DMRC
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