

Cost-effective HIP post-treatment of aluminum materials

Since aluminum materials have such low density, they are ideal for the additive manufacturing of lightweight components using laser powder bed fusion (LPBF). However, economic aspects prevent it from being widely used in the industry. A significant increase in process build-up rates is possible through increasing layer thicknesses, laser beam diameters and laser power. However, these favor the formation of defects such as gas pores, thus resulting in reduced relative component densities and insufficient fatigue strength.

Post-treatment using hot isostatic pressing (HIP)

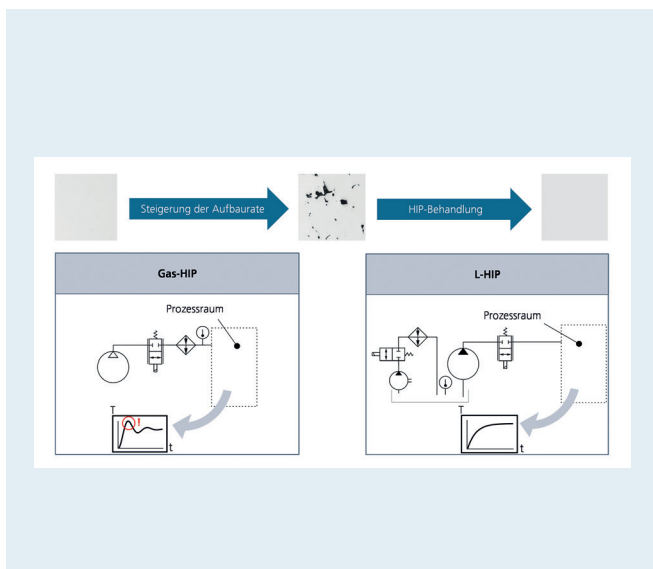
In the HIP process, internal defects in the component such as gas pores, bonding defects and cracks are sealed by diffusion processes, plastic deformation and creep when pressure and temperature are applied. This can significantly improve the fatigue strength properties of the material in particular. Conventional HIP systems use gases as the active medium and temperatures between 800 °C and 1000 °C during the pressing process. Corresponding gas-based HIP post-treatments are, therefore, very costly and only make economic sense for high-melting-point materials such as titanium, steel or nickel-based alloys. Due to their low melting temperature, aluminum alloys cannot yet be post-treated using the HIP process.

Development of the liquid-based HIP process

Since it uses liquid instead of gaseous active media, Fraunhofer ILT, along with ifas at RWTH Aachen University, is developing a cost-effective HIP process as part of a current R&D project. The process can also be used for aluminum alloys due to shorter holding times, lower process temperatures and reduced energy consumption. The combination of the highly productive LPBF process with the cost-effective, liquid-based HIP process should significantly reduce the overall production costs of LPBF components made of aluminum.

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1 Comparison of the conventional gas HIP and liquid-based L-HIP process.



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