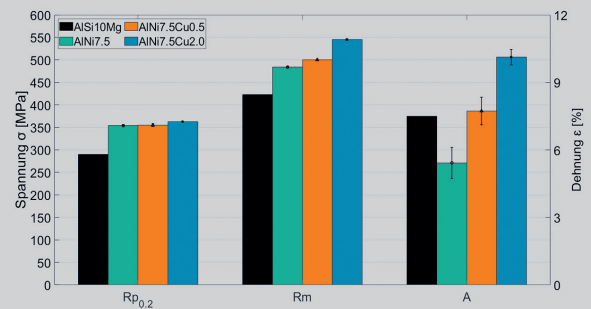


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HIGH-STRENGTH AL-ALLOY FOR ADDITIVE MANUFACTURING

Task

The market for aluminum-based alloys for additive manufacturing is currently dominated by commercially available aluminum-silicon alloys (e.g. AlSi10Mg). These alloys, however, have insufficient mechanical properties for broader applications (e.g. in structural components). Other commercially available aluminum alloys that achieve the required mechanical properties either cannot be processed by additive manufacturing methods (e.g. 6XXX or 7XXX series) or contain expensive strengthening agents (e.g. Scalmalloy®). The work presented here aims, therefore, to develop an economical Al-based alloy that can be processed by additive manufacturing and has tensile strengths > 500 MPa and elongations at break > 10 percent.

Method

Eutectic Al-Ni alloys were identified as promising candidates for investigation with additive manufacturing processes. Al 7.5 wt. percent Ni (AlNi7.5) was selected as a binary base alloy to be studied with laser powder bed fusion (LPBF). Based on the binary composition, strengthening agents were added to enhance the mechanical properties through solid solution and precipitation hardening. The selection of the strengthening

agents was based on simulated phase diagrams. Test specimens of the alloys under investigation were analyzed in terms of their mechanical properties and how well they could be processed (pores, cracks).

Results

Parameters were identified to build components that were crack-free and had part densities > 99.9 percent, thereby confirming that the binary Al-Ni alloy and the ternary Al-Ni-Cu alloys can be successfully processed. The addition of Cu to the binary alloy results in increased ultimate tensile strength and elongation at break up to 545 MPa, or 10.1 percent, respectively. Thus, the mechanical properties obtained in the processed state exceed those of the commonly used AlSi10Mg alloy. The addition of further strengthening agents is being investigated in ongoing work.

Applications

As emission and weight need to be reduced, automotive and aerospace sectors, in particular, could profit from a broad application of lightweight components. The project presented here is being carried out jointly with Fraunhofer Institutes IWM and IGCV as part of the Fraunhofer-Gesellschaft's strategic pre-market research.

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- 1 Stress-strain diagram of the investigated alloys.
- 2 Determined mechanical properties of the investigated alloys.