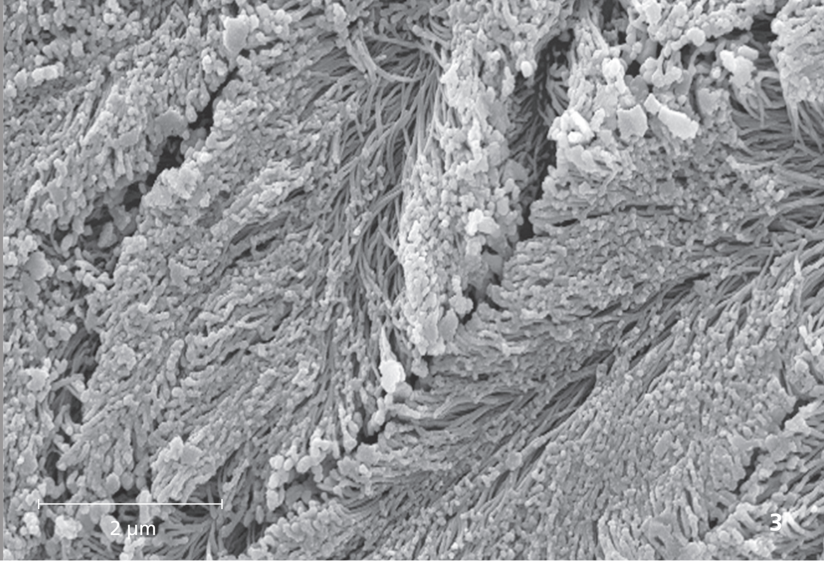

DEVELOPMENT OF A HIGH STRENGTH/HEAT RESISTANT AL-ALLOY FOR ADDITIVE MANUFACTURING

Task

The market for Al-based alloys for additive manufacturing is today defined by commercially available AlSi alloys and Scalmalloy®. Especially at elevated temperatures (~ 250-300 °C), however, AlSi alloys exhibit insufficient mechanical properties. Scalmalloy® has significantly better mechanical properties, but since scandium – a rare earth metal – is used, it is expensive and, therefore, only attractive for special applications. Conventional wrought Al alloys are not an alternative since they cannot be processed with additive manufacturing processes as they are prone to hot cracking. The work presented here aims, therefore, to develop a less expensive alloy with properties comparable to those of Scalmalloy®.

Method

In laser-based additive manufacturing, eutectic AlNi alloys have been identified as promising candidates for investigation. Starting from the binary composition, alloying additions are added in order to enhance the mechanical properties by precipitation hardening. The selection is based on simulated phase diagrams. Rapid experimental validation is performed by means of laser material deposition (LMD). A graded setup allows chemical composition to be varied over the setup height so that an interval of chemical compositions can be analyzed within a single sample.

Results

The binary Al-Ni base alloy (7.5 wt.% Ni) has successfully been processed with AM (LMD and laser powder bed fusion (LPBF)), which is confirmed by the lack of cracks and high component density > 99.9 percent. The hardness values determined (~ 160 HV) in the processed state are greater than comparable values for the alloy AlSi10Mg (~ 125 HV). Current research is identifying further mechanical properties and investigating how the addition of different strengthening agents influences the mechanical properties of the promising binary AlNi alloy.

Applications

The research presented here could be of interest to the automotive and aviation sectors as these new alloys can potentially replace Fe-Ti-based alloys. In particular, by broadly using such alloys with improved mechanical properties, these sectors will not only be able to save weight, but also reduce emissions. Increasing demands, e.g. due to downsizing of components, also require higher strength/heat-resistant materials.

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3 SEM image of eutectic Al-Ni fibers.