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## In-situ LENS fabricated Ti–Al–Si alloy phase transformation and microstructural evolution after isothermal annealing heat treatments

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**Abstract**

Gamma titanium aluminide ( -TiAl) alloys are lightweight materials with potential application for high-temperature components. But their ductility at room temperature impedes widespread production of parts via traditional processing routes. In this work, intermetallic Ti–Al–Si alloy was produced via laser in situ alloying from elemental powders by applying the laser engineered net shaping (LENS) technique. Isothermal annealing heat treatment was carried out at 1200, 1300, and 1400 °C for 1 h, followed by furnace cooling (FC). A second homogenization heat treatment was done at 850 °C for 6 h followed by FC. The microstructure was characterized by optical microscopy, (OM), scanning electron microscopy (SEM) equipped with an electron dispersion spectroscopy (EDS), and electron backscattered diffraction (EBSD) technique. The result shows precipitates of silicide ( -Ti5Si3) grains with lamellae microstructure in the as-built Ti–Al–Si samples, while dense columnar grains of fully lamellar (FL) microstructure comprising of a2-Ti3Al and -TiAl were observed for the 1300 °C/1 h/FC/850 °C/6 h/FC heat-treated sample with -Ti5Si3-phase at the grain boundaries. The high microhardness values of the samples were ascribed to the presence of -Ti5Si3-phase being formed. This study established that laser in-situ alloying with standard heat treatment is feasible for the development of TiAl-based alloys.