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Abstract

Oxide dispersion strengthened (ODS) FeCrAl alloys are promising candidates for aggressive environments and accident tolerant fuel cladding application due to their high strength and oxidation resistance at elevated temperatures. Conventionally, mechanical alloying of FeCrAl with yttria nanoparticle followed by hot consolidation was used to manufacture ODS FeCrAl alloy.

Experimental

Gas-atomized Fe-24Cr-8Al-0.5Y (wt.%) powder was procured from Orlikon Metco (D50=33µm), and used in SLM printer (OR Creator). The SLM parameters include Laser power; 100 W, Laser scan speed; 50-600 mm/s, Layer thickness; 30 µm and hatch spacing; 50 µm

Results and Discussion

Figure 4 reveals precipitation of fine and spherical nanoparticles in the range of 20-100 nm. Formation of spherical nanoparticles implied that Y and Al precipitated in-situ within the matrix during solidification of SLM. This study showed that by using SLM process, an ODS FeCrAlY was additively in-situ manufactured with less steps and time. Room temperature mechanical properties (e.g. hardness) of SLM FeCrAlY (335±8 HV) was acceptable compared to the closest available composition of conventionally manufactured FeCrAl alloy (Fe-15Cr-5Al-0.5ZrO2-0.5Y2O3) with 388±7 HV hardness.

Conclusions

This study showed that by using SLM process, an ODS FeCrAlY was additively in-situ manufactured with less steps and time. Room temperature mechanical properties (e.g. hardness) of SLM FeCrAlY (335±8 HV) was acceptable compared to the closest available composition of conventionally manufactured FeCrAl alloy (Fe-15Cr-5Al-0.5ZrO2-0.5Y2O3) with 388±7 HV hardness.

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