



Si₃N₄ – Aluminium Composite

12 September 2017

Nuenz has prepared small samples of F80.FS4.15 Silicon Nitride Fibre reinforced 2XXX premix aluminium powder. F80.FS4.15 is our special formulation for aluminium powder composites. These composites were prepared by powder metallurgy and the mechanical properties were evaluated to show that the composites had improved mechanical properties over reference powders.

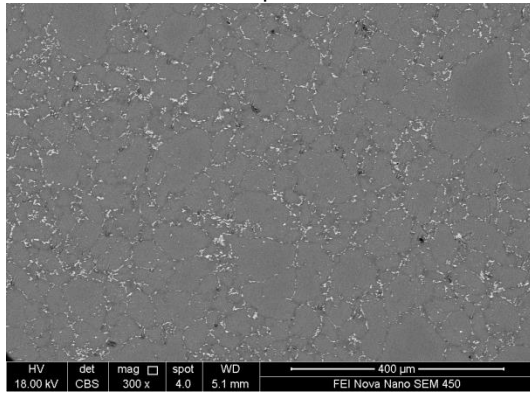
Matrix	Aluminium 2XXX	F80.FS4.15
Additive	-	0.5 vol%
Hall Flow (s/50g 5mm)	22.8 ± 0.2	21.9 ± 0.4
Compaction Pressure (MPa)	300	300
Green density (g/cm ³)	2.62	2.62
Sintered density (g/cm ³)	2.76	2.75
Hardness (Rockwell B)	T1: 28 ± 3	T1: 36 ± 3

Flow analysis of the powder showed that there was good dispersion of ceramic additive onto the matrix metal powder. Poor mixing leads to fines in the intergranular space causing bridging which significantly impacts the flow characteristics.

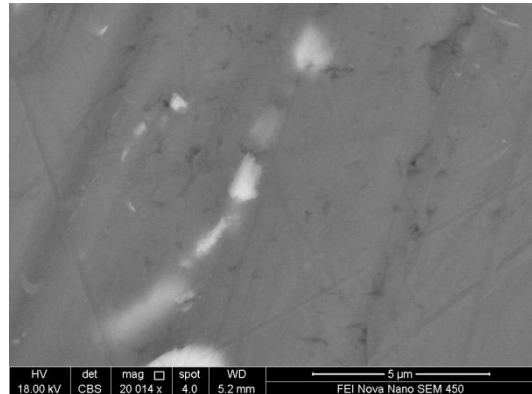
Microstructural analysis (optical) of the sintered samples showed that the Si₃N₄ reinforcement was highly dispersed in the grain boundaries with no observable agglomeration. Dispersion strengthening can be observed in the grain boundaries with discrete sub-micron silicon nitride particles in the completely sintered intergranular space.

Nuenz has observed that dispersion is related to mechanical properties with higher mechanical properties observed in dispersed 0.5% F80.FS4.15 compared to higher-loaded composites that are more likely to aggregate.

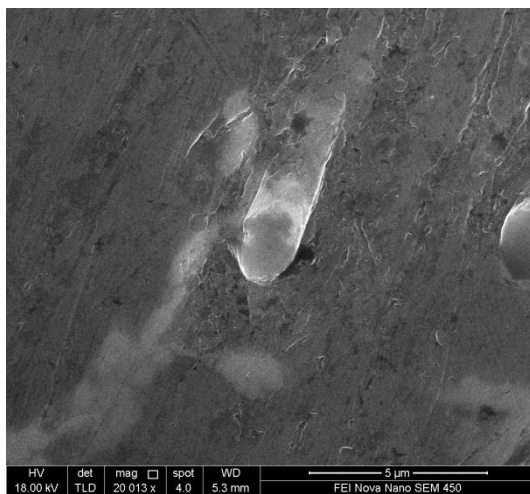
0.5% F80.FS4.15 Composite



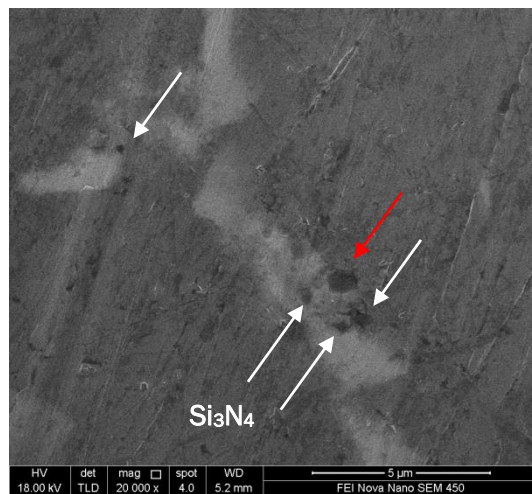
300x back scatter image showing low porosity



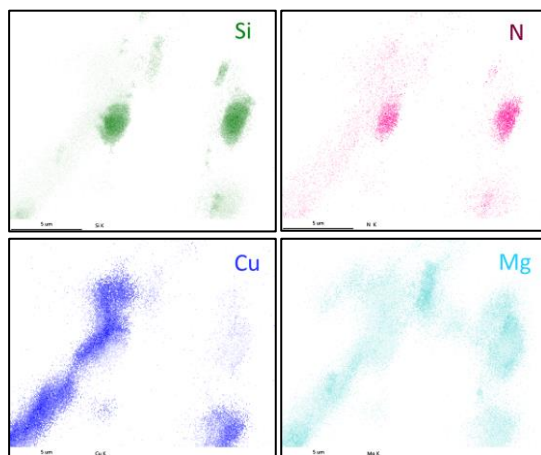
20,000 back scatter image showing sintered grain boundary with Cu concentration



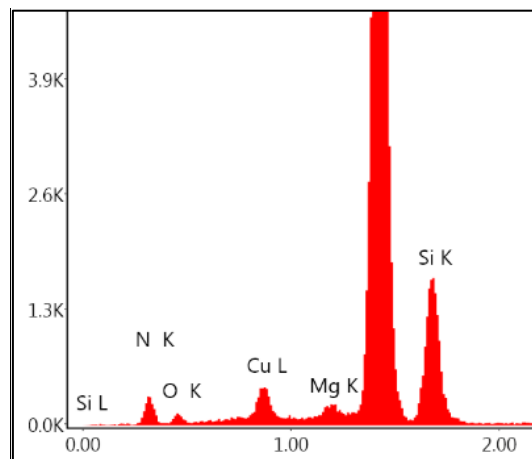
20,000x SEM image showing Si₃N₄ fibre in grain boundary



20,000x back scatter image of grain boundary showing dispersed Si₃N₄



EDS map of image above showing identification of Si and N in exposed fibre surfaces



EDS Spectra of Si₃N₄ particle in above image showing concentrations of Si and N in AlCuSiMg alloy