Supplementary Material

A new Zr-rich intermetallic phase in an Al-14Si-3Cu-4.5Ni casting alloy with trace additions of Zr

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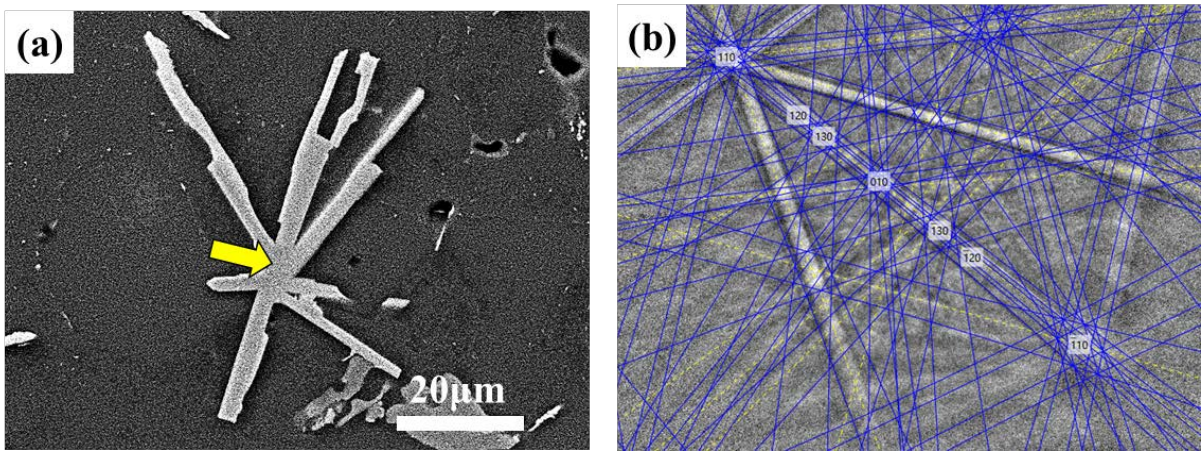
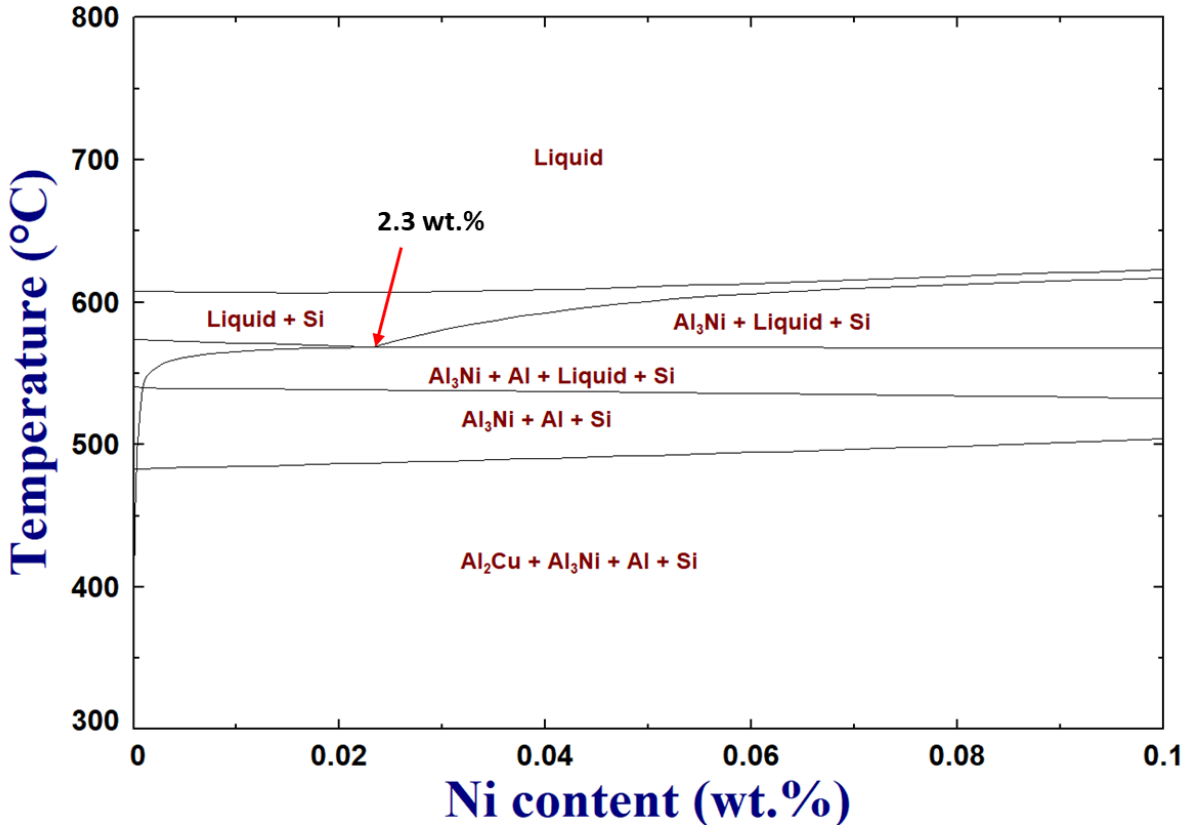
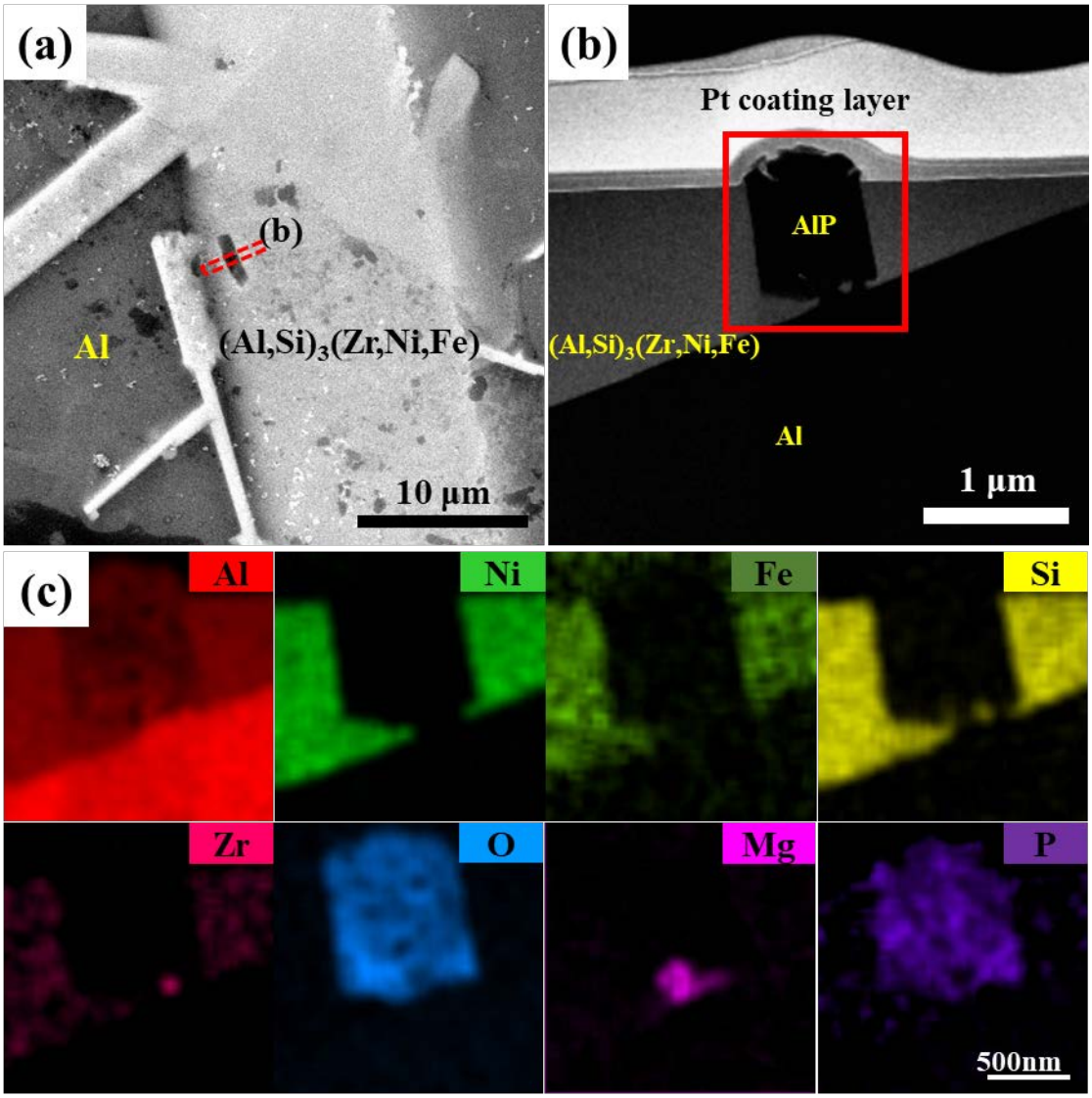


Supplementary Figure S1 (a) SEM images showing an $(Al,Si)_3(Zr,Ni,Fe)$ intermetallic phase in the as-cast Al-14Si alloy and (b) the corresponding EBSD diffraction pattern with simulated bands based on the crystallographic information derived from TEM analysis in Figs. 3(c) and (d).



Supplementary Figure S2 A calculated isopleth of Al-14Si-3Cu-Ni system using FactSage with a FTlite database [27].



Supplementary Figure S3 (a) SEM image showing an $(Al,Si)_3(Zr,Ni,Fe)$ phase containing an internal particle in the as-cast Al-14Si alloy and (b) the cross-section image in the FIB sample. (c) EDS maps analyzed on (b) the squared area, exhibiting the distribution of constituent elements.

S3(a) shows a SEM image exhibiting an $(Al,Si)_3(Zr,Ni,Fe)$ phase selected for FIB preparation of the TEM sample. Cross-sectioning across the dotted line in **S3(a)**, an internal particle was observed to exist within the $(Al,Si)_3(Zr,Ni,Fe)$ phase as shown in **S3(b)**. EDS mapping on the squared area of **S3(b)** reveals that the distribution of P corresponds well with the internal particle while the surrounding phase consists of Al, Si, Ni, Fe and Zr, which are mainly present in the $(Al,Si)_3(Zr,Ni,Fe)$ phase, as shown in **S3(c)**. The P-rich particle is most likely AlP phase and its instantaneous oxidation nature could lead to the transformation into $AlPO_4$ as evidenced in the distribution of oxygen (O) overlapping with that of P (see **S3(c)**). The presence of AlP within the $(Al,Si)_3(Zr,Ni,Fe)$ phase importantly suggests the potent role in nucleating the Zr-rich intermetallics and is to be further discussed in this study.