# Characterization of the formation of the Zn/Fe intermetallic phases at the surface of 2 galvannealed steels with different Si concentrations

Martin Arndt

voestalpine Stahl GmbH, voestalpine-Straße 3, 4020 Linz, Austria
martin.arndt@voestalpine .com

Galvannealing of steel means you first start with hot-dip galvanizing. After the steel strip leaves the liquid Zn bath excessive Zn is blown away by air knives and the strip is annealed for only a few seconds at temperatures between 500 and 565°C in order to create Zn/Fe intermetallic phases. The phase transitions must be completed before the steel strip reaches the first roll. If the amount of Si is increased in modern steels to about 1,5 wt.-% in order to archive better mechanical properties of the steel, it was observed that the annealing process is massively slowed down.

The aim here is therefore understanding what causes this deceleration of the Fe diffusion into the Zn layer. And the first step in order to archive it is to find characterization tools which can show the phase developments in the Zn layer.

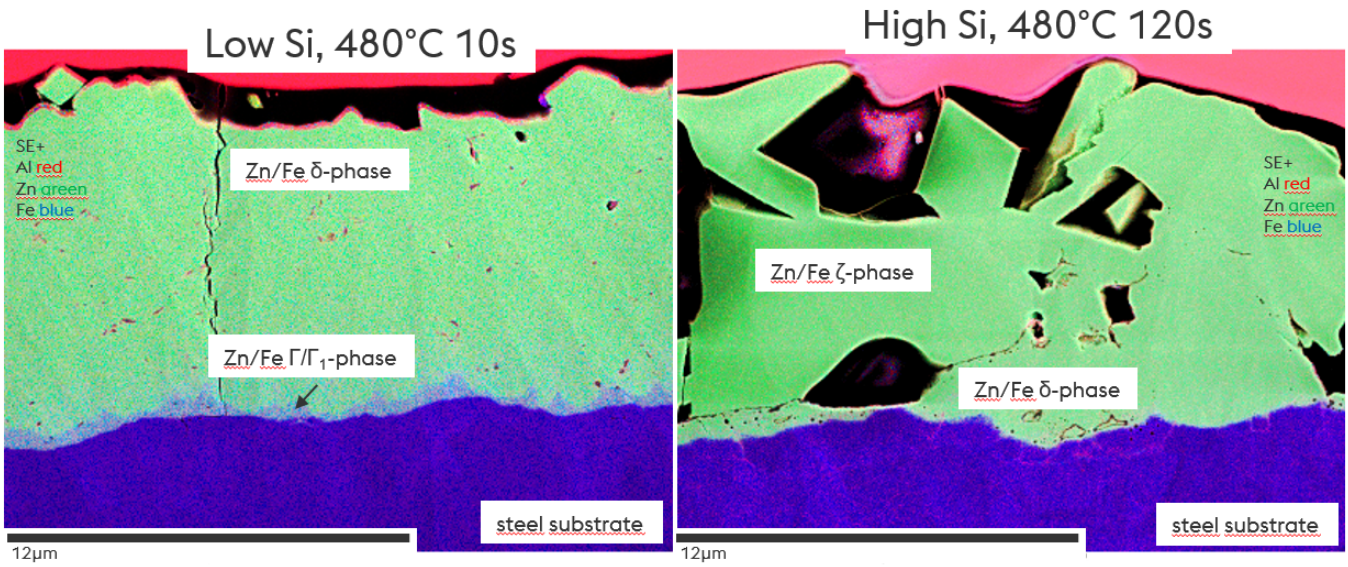


*Figure 1 Comparison of 5kV EDX element mappings of cross sections prepared via Ar ion polishing of low and high Si containing steels after annealing at 480°C. The images show an overlay of the secondary electron image with the elements Al, Zn, and Fe in red, green, and blue*

So far, the measurement technique of choice is a proper cross section preparation via Ar ion polishing and subsequent EDX-element mapping at low primary beam energy in order to archive a compromise between good lateral resolution and distinguishability between Zn/Fe phases, for example the difference between ζ- and δ- phase is only about 1.5 wt.-%. An example is shown in Figure 1. Other methods were also used for confirmation of the findings like XRD, AES, XPS, GDOES, and TEM.

There are a lot of difficulties and measurement artefacts in EDX when measuring low concentration of elements like Si and Al at that special prepared surface due to geometry and sum peaks and I want to show some of these aspects which I found.
I also want to give an explanation for the different Fe diffusion behavior of the two steels.