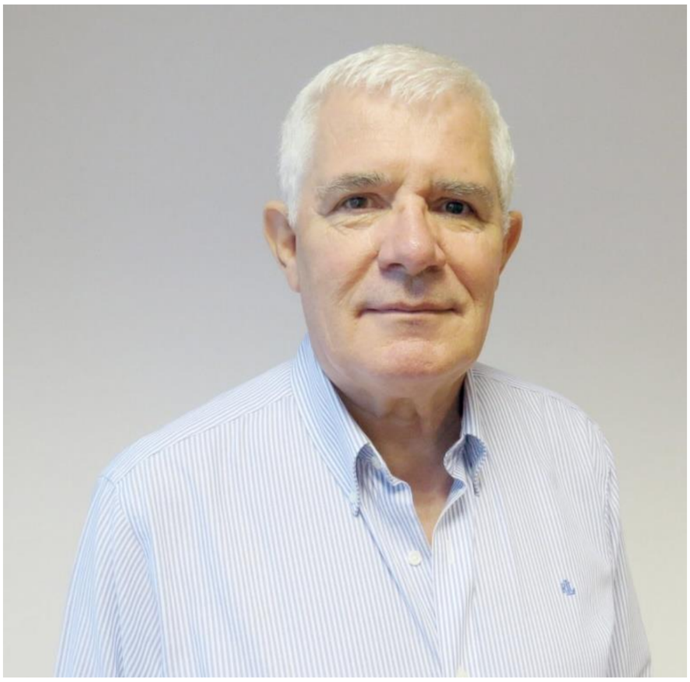
Keynote speakers

K01. The foundry processes. From Art to Science



Ramón Suárez (rsuarez@azterlan.es)

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Abstract. The manufacture of cast components is a complex process that involves a large number of variables. Additionally, to obtain a component that meets the specified requirements, it is necessary to avoid the formation of defects that may render its commissioning unusable. defects may invalidate the functionality of the component.

Generally, in the foundry world, the rejection of castings is measured in percentage. This carries the risk that an unsuitable component may be sent to the final customer. Unfortunately, due to the fact that, currently, the scrap is measured in percentage, it is needed to see the problem in a different way and, with the aim to produce perfect components generated tools such as Smart Manufacturing, Digital twin, permanent auditors' techniques, among others.

This work shows how it is possible to reduce the internal and external scrap rate dramatically by applying Artificial Intelligence techniques, also combining the expert knowledge, data collection, prediction tools, and being managed by a digital twin. All this ecosystem will identify on the production line molds that do not fulfill the requirements, avoiding deviations and, finally, reducing drastically customer complaints.

K02. Powertrain Trends: The Outlook for Cast Iron

Steve Dawson (steve.dawson@sintercast.com)

President & CEO, Sintercast Group, UK

Abstract. Media reports often suggest that the automotive industry will be all-electric, tomorrow. Sometimes sooner. But over the past year, as sales slow in both the US and Europe, the narrative has started to evolve from euphoria to realization. New development is rarely fast or easy. Electrification still needs to overcome challenges related to raw materials, charging infrastructure, driving range, total cost of ownership, government subsidies and consumer acceptance. The size of these challenges increases as the size of the vehicle and the demand of the duty cycle increase from cars to pick-up trucks and commercial vehicles. The presentation will provide an overview of recent legislation in Europe and America, and how the legislation influences the development of new powertrain technologies, new fuels, and the demand for cast iron cylinder blocks and heads.

K03. Time-resolved X-ray imaging and diffractometry of ferrite-austenite transformation following ferrite solidification in steels

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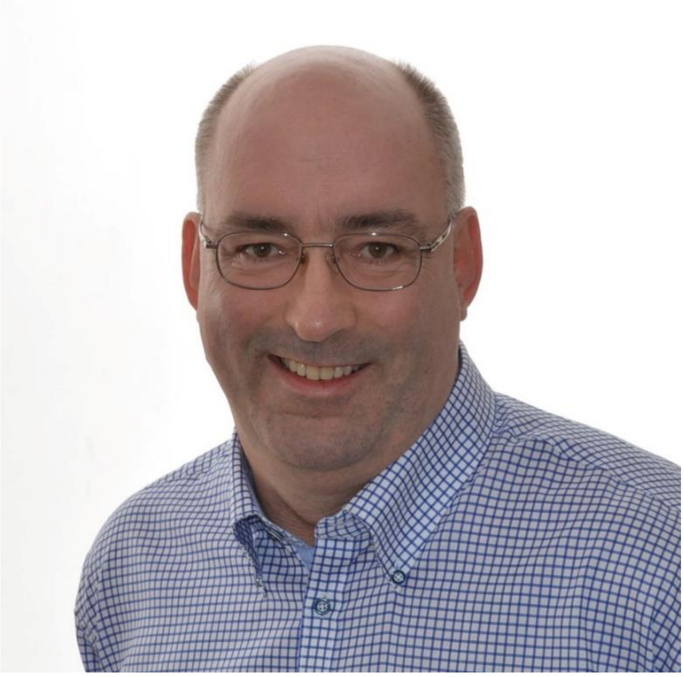
Abstract. Unevenness and cracks in the solidifying shell are the recognized casting defects in the peritectic steels. The formation of these defects has been discussed on the basis of the peritectic reaction/solidification, where the growth of the austenite (FCC) was controlled by carbon diffusion in the ferrite (BCC) and/or the liquid. Recently, our X-ray imaging using synchrotron radiation X-rays has demonstrated that the ferrite massively transformed in the austenite even in the steady state growth even at a rate as low as 0.05 mm/s, producing the fine austenite grains through this transformation (referred to as massive-like transformation). Understanding the solidification phenomena and the formation mechanism of casting defects in steel is of great interest because a deep understanding can contribute to the improvements in casting/solidification processing. This presentation will cover the solidification, the massive-like transformation and the austenite grain coarsening. We have performed time-resolved X-ray transmission imaging and time-resolved tomography with X-ray diffractometry. According to the observations, once the austenite nucleated at temperatures below the peritectic temperature during/after the ferrite solidification, the ferrite massively transformed into the austenite and the remaining liquid rapidly solidified in the solidification of carbon steels and Fe-Cr-Ni alloys. The austenite grains coarsened immediately after the massive-like transformation. The volumetric strains in the solidifying shell were evaluated based on the observations. The model revealed a sharp peak in the volumetric strains caused by the massive-like transformation at hypo-peritectic compositions. The results suggest that the massive-like transformation is crucial for understanding the solidifying shell deformation in peritectic steels.

K04. Graphite Nucleation on Silicate Phases



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Abstract. The present investigation is undertaken with the objective of studying nucleation of graphite in cast irons. Graphite is found to nucleate heterogeneously on non-metallic micro-particles such as oxides, sulphides, and nitrides. After inoculation by ferrosilicon-based alloys it has been found that specific alumino-silicate phases are formed on the surface of magnesium-containing particles from the nodularising treatment. Calcium, strontium and barium silicates produced from the inoculant have crystal structure resembling the graphite. Highly coherent lattice match is found between the silicates and graphite providing favourable conditions for nucleation at small undercoolings.

Due to the very small nature of these silicate phases, it has proven difficult to detect their presence in conventional cast irons even by advanced high resolution electron microscopy. In the present investigation, attempts have been made to produce synthetic specimen of the favourable silicate substrates. Such substrates subsequently have been exposed to solidifying cast iron to facilitate nucleation and growth of graphite on their surfaces. Finally, scanning and transmission electron microscopy investigations of graphite-silicate interfaces have been made to reveal their crystalline characteristics.

K05. The Fracture of Metal Castings

John Campbell (jc@campbelltech.co.uk)

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Abstract. Nearly all our engineering metals are filled with cracks by our turbulent casting processes. This gives rise to the various fracture modes, including simple tensile fracture, fatigue, creep, stress corrosion cracking, and hydrogen embrittlement. All are caused by turbulent casting. Some, particularly the vacuum arc remelting process appears to cause cracks so serious as to bring down aircraft, especially helicopters. The helicopter failure modes from etch pits in drive trains is a common VAR failure causing tragedies. New technology to reduce turbulence will be outlined, and results illustrating the improvement to Ni alloys and steels will be presented.