



Bridge You and Nano

Exponential Business and Technologies Company

Microporosity Measurement of Zn-Al Casting by Quantitative Image Analysis

The automation of metallographic measurements using quantitative software image analysis has made many measurements much more efficient and repeatable. Computer software can count grain and particle size, identify nonmetallic inclusions, and calculate porosity more efficiently than traditional manual methods. In this app note, the micro porosity of a Zn-Al casting is measured to demonstrate how the quantitative image analysis works.

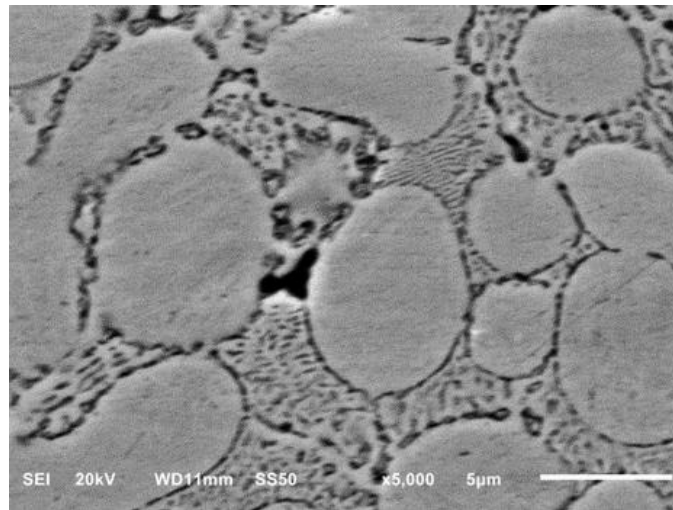


Figure 1. Typical microstructure of the Zn-Al alloy

Figure 1 shows the typical microstructure of a Zn-Al alloy. The alloy is composed of a lamellar eutectic α phase (dendrite network) and a zinc-rich η phase. In cast zinc, Al can refine the grain size and form a fine equiaxed grain structure. This can improve the strength, ductility, and toughness of zinc castings. Tiny holes form between the arms of the dendritic network due to gas evolution during the solidification process. In this sample, the relatively large pores are shrinkage cavities, which are more or less fissured and cave like in shape. It is impossible to completely remove shrinkage cavities in Zn-Al castings.

In this work, pores larger than 5 μm were selected for porosity measurement. Based upon practical applications or customer requirements, different pore sizes can be selected to calculate the porosity of the casting. To determine the effects of image magnification on porosity measurement, 200X and 500X micrographs are compared. For each magnification, five random areas were selected to measure the porosity of the casting. Figure 2 shows a typical distribution of pores within the Zn-Al casting.



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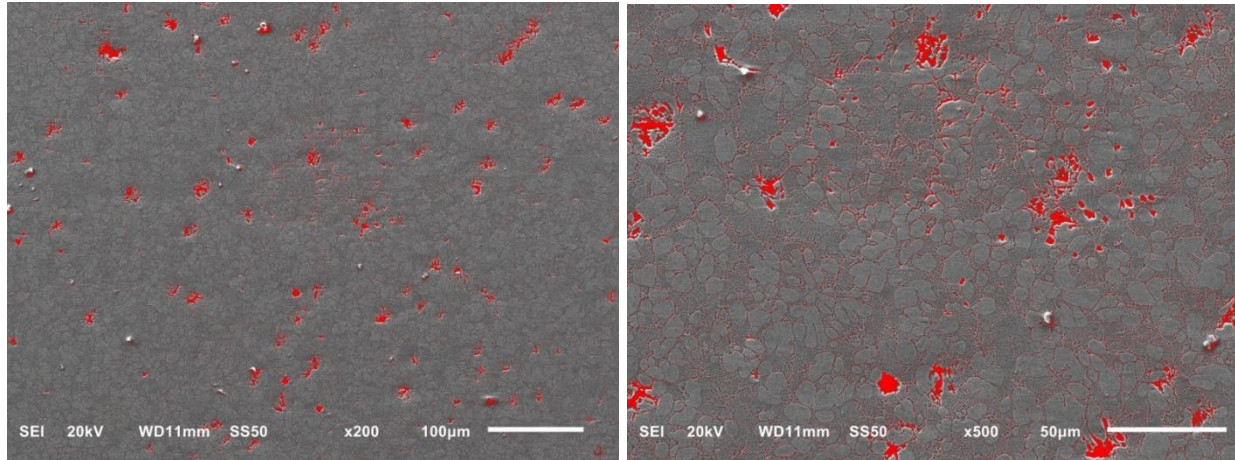


Figure 2. Typical porosity measurement results using 200X (left) and 500X (right) magnification. (Pore sizes less than 5 μm were excluded from statistical calculations.)

Table 1 lists the porosity measurements with 200X and 500X magnifications. Based upon the results of the image analysis software, the average pore areas measured at 200X and 500X magnifications were very similar, around $19.74 \mu\text{m}^2$. The porosities (or percentage of the total image area occupied by pores) were consistent when measured at 200X and 500X magnification.

Table 1. Porosity measurement results with different magnifications

	200X Magnification		500X Magnification	
Area	Average size (μm^2)	Percent area (%)	Average size (μm^2)	Percent area (%)
1	19.80	0.98	17.91	1.38
2	18.76	1.13	21.42	1.36
3	23.95	1.37	24.72	0.97
4	18.78	0.92	20.65	1.15
5	17.51	0.75	13.93	0.86
Average	19.76	1.03	19.72	1.15