Clean Metal Processing: New Avenues for Measurement, Mitigation, and Analysis of Quality Detractors in Aluminum Melts

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Introduction

In general the cleanliness of aluminum alloys is referred to as controlling the concentration of dissolved inclusions, dissolved hydrogen, and residual elements. It has been shown that cleaner metal results in: greater metal fluidity and feeding capability during casting, higher casting properties, improved machinability, better surface finish, and overall reduction in reject castings.

Two major classes of impurities can be distinguished in molten aluminum as dissolved elements (hydrogen, alkali and alkaline earth metals, and transition metals) and suspended particles. There are several sources of these impurities include surface turbulence, pouring atmosphere, and the interactions between the molten metal and refractory materials. Melt quality can be controlled by the removal of these elements and particles. Depending on their size and concentration, they can affect both the mechanical and surface properties of the final product. Therefore, various technologies exist to measure and remove these impurities.

The objective of this work is to explore new methods of measurement and mitigation of quality detractors in aluminum melts via laser induced breakdown spectroscopy (LIBS) and chemical and centrifugal filtration.

Methodology

The Research effort is divided into three main tasks:

1. Develop a method to form aluminum alloys with specific levels of cleanliness for measurement and filtration experiments.
2. Perform LIBS in the melt to correlate spectrographic data to hydrogen/inclusion level.
3. Develop a filtration process to remove quality detractors by centrifugal and possibly chemical action.

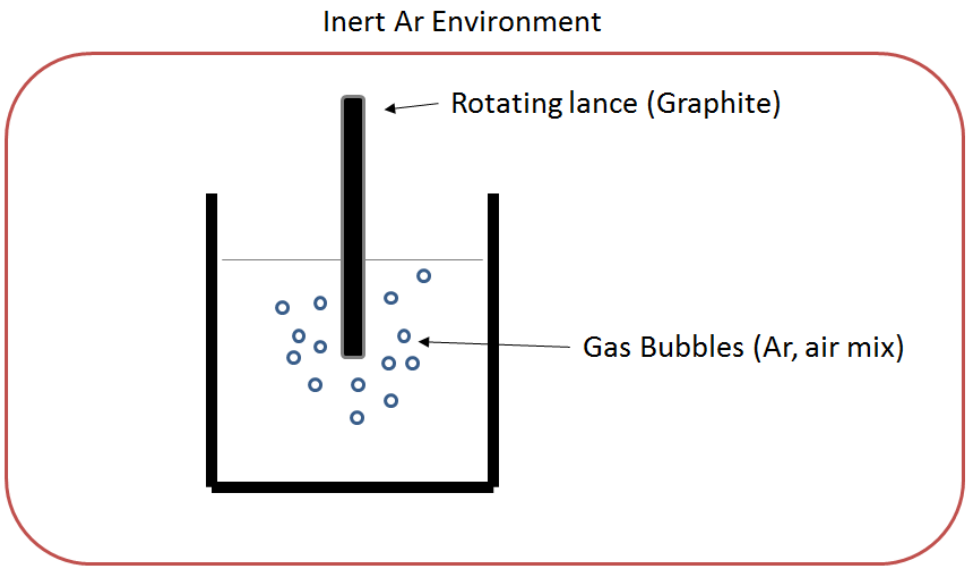

Fig 1. Schematic of the Method to introduce inclusions and hydrogen into the melt

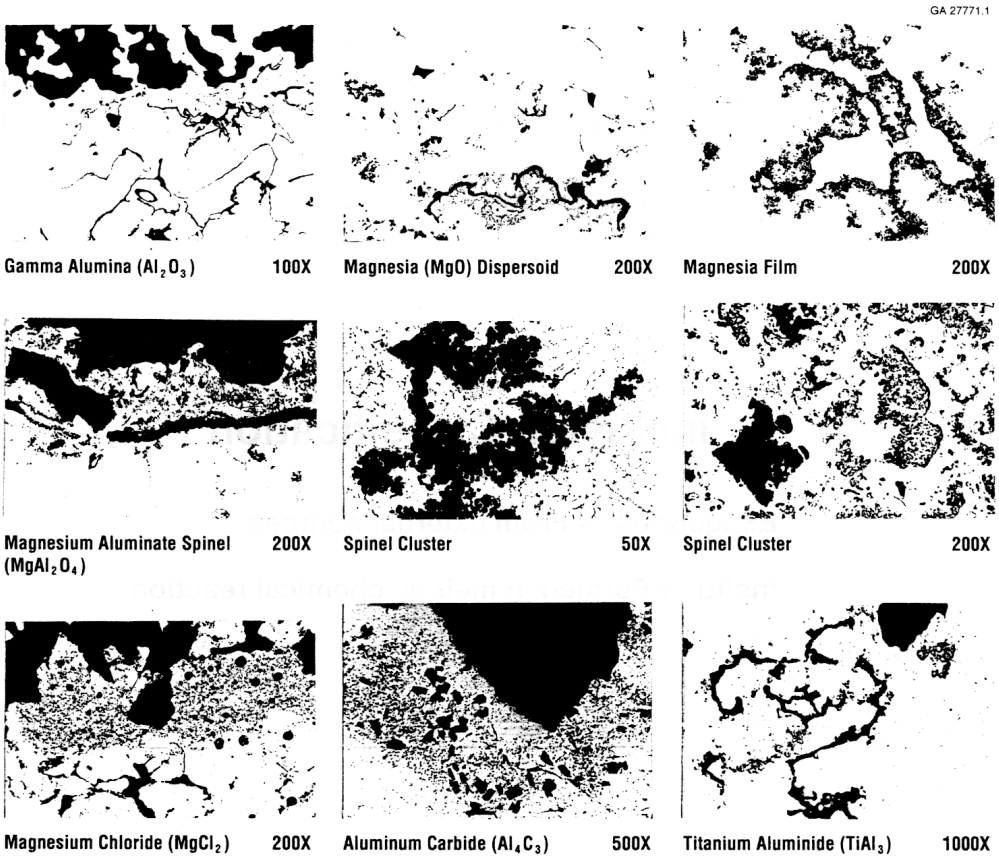

Fig 2. Micrographs of common inclusions in aluminum castings