## Introduction

Non-metallic inclusions such as Al_2O_3, $MgAl_2O_4$ and Al_4C_3 are the most undesired impurities in Al-melts as they invariably cause a decrease of mechanical property and surface quality of the products. To remove those inclusions more efficiently and economically, a reliable quantitative inclusion analysis method and an in-depth understanding of inclusions behaviour are prerequisites. Starting in 2013, Project 4 focused mainly on the research of inclusion quantification techniques and particle behaviour in Al-melts. Three main work packages namely Ultrasound (US), Laser Induced Breakdown Spectroscopy (LiBS) and Particle Behaviour were proposed and executed within the project.
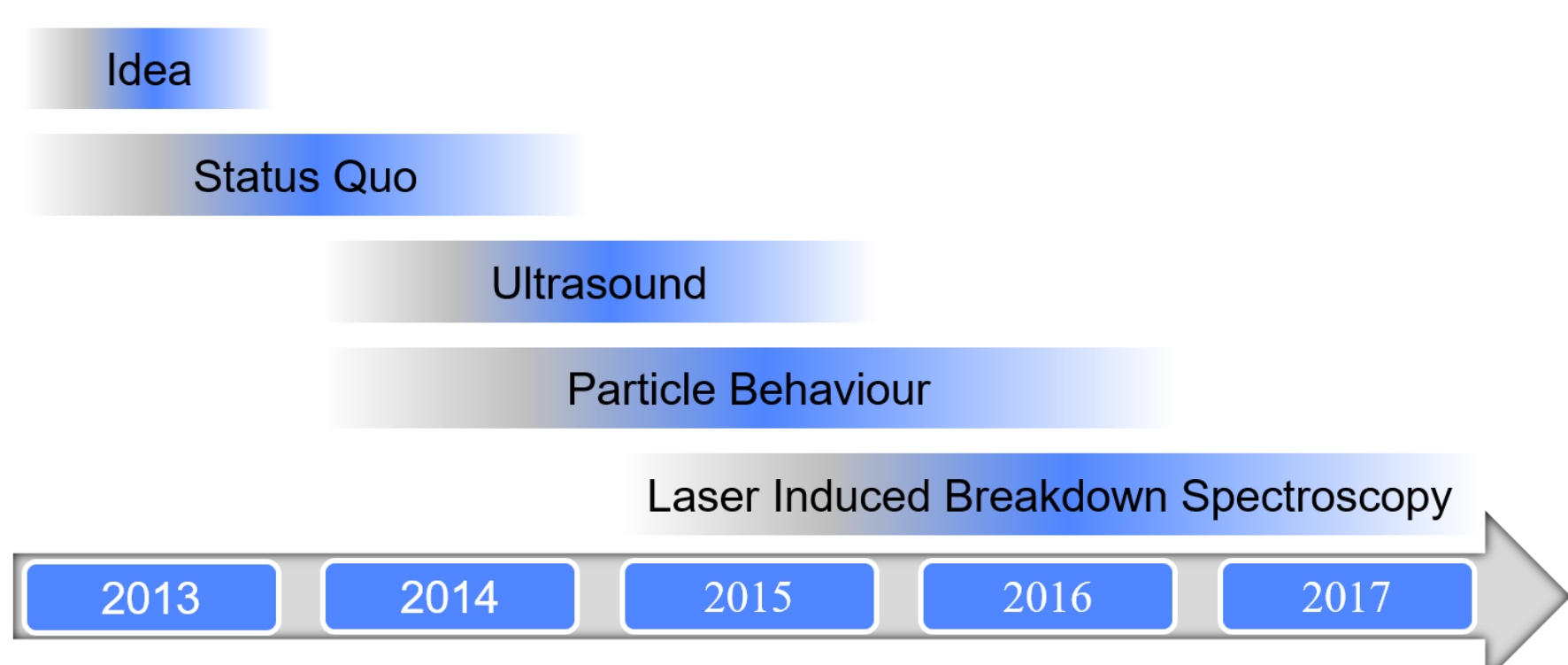
Timeline of P4

Ultrasound

The goal of US Work Package was to develop a laboratory prototype capable of monitoring melt quality. Through ultrasound field tests, key components and operational parameters of the prototype for a high particle detection sensitivity, signal strength and corrosion resistance were determined.
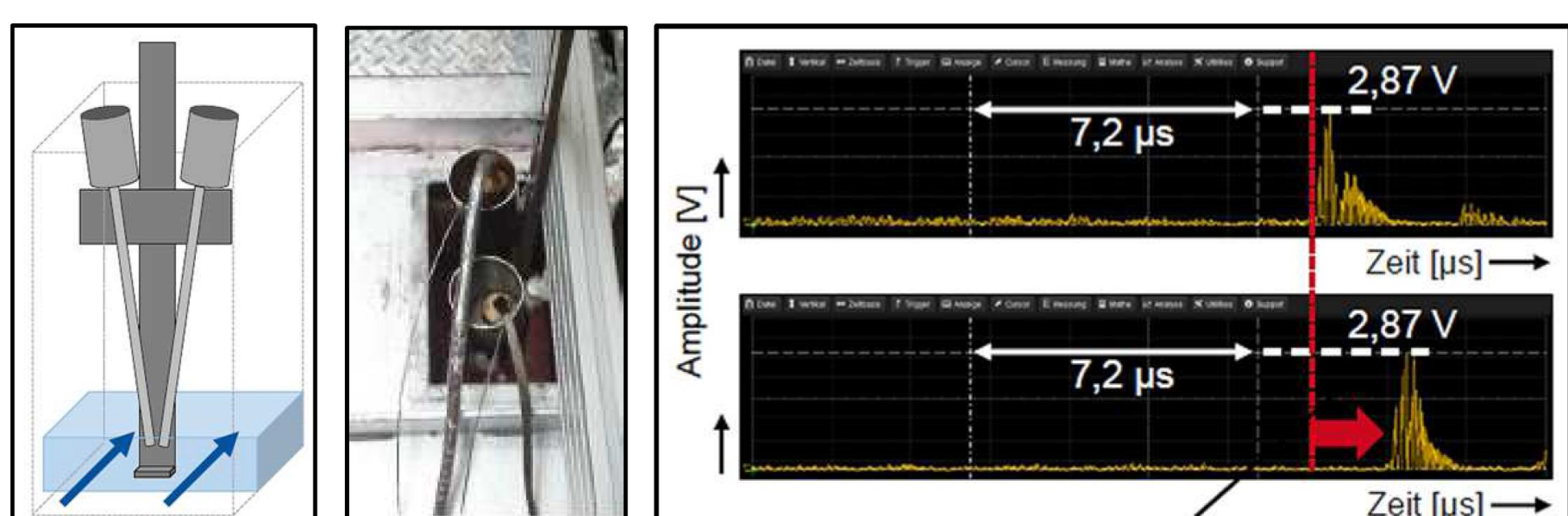

Schematic drawing of the "US" equipment prototype coupling with launder; Corresponding photo of the equipment; A reduction of signal disturbance in the test.


LiBS

The goal of LiBS Work Package was to assess the feasibility of applying Laser Induced Breakdown Spectroscopy method on molten metal inclusion detection. Through lab-scale tests sensitivity of LiBS to certain inclusions in Al-melts was validated. Afterwards a wrought alloy test was done, during which robustness of the LiBS prototype was proven.
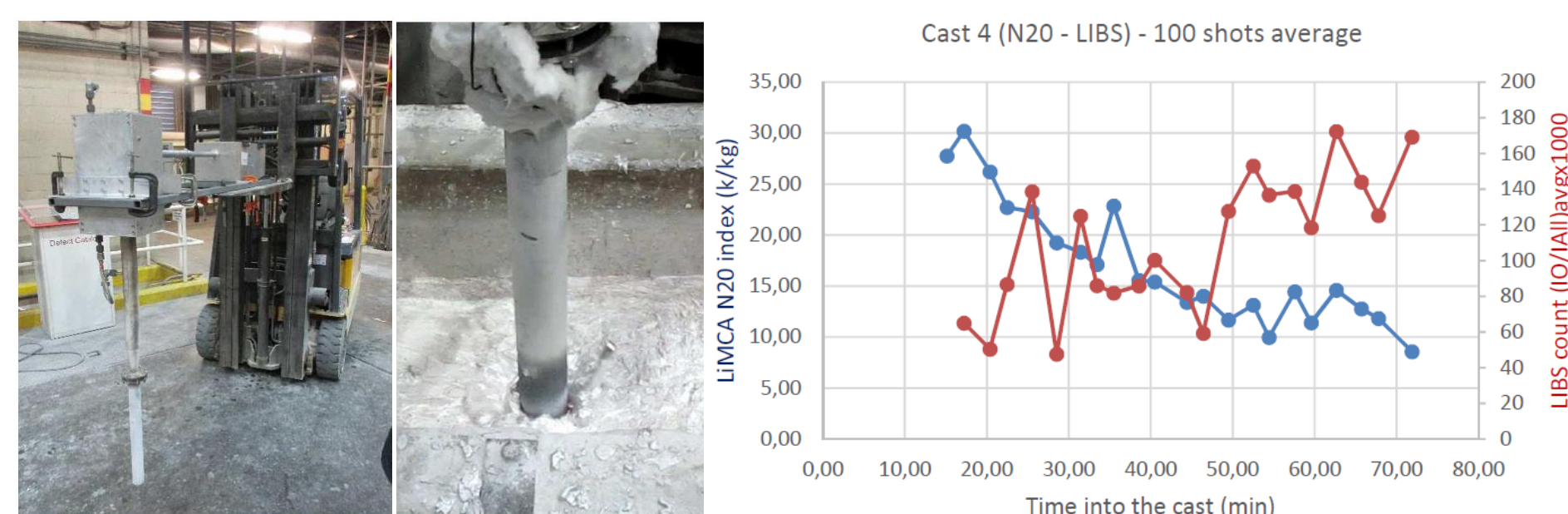
LiBS equipment; The running LiBS in a launder;
A comparision between LiBS and LiMCA (Liquid Metal Cleanliness Analyzer)

Particle Behaviour

The goal of Particle Behaviour Work Package was to improve know-how in settling and agglomeration tendencies of inclusions in Al-melts. A setup was built and validated which allowed the monitoring of inclusions through a LiMCA unit in settling trials. A basic mathematical model was established to understand the terminal settling velocities of particles with different chemistries. Meanwhile lab-scale experiments demonstrated the relation of agglomeration tendency and wettability of inclusions.
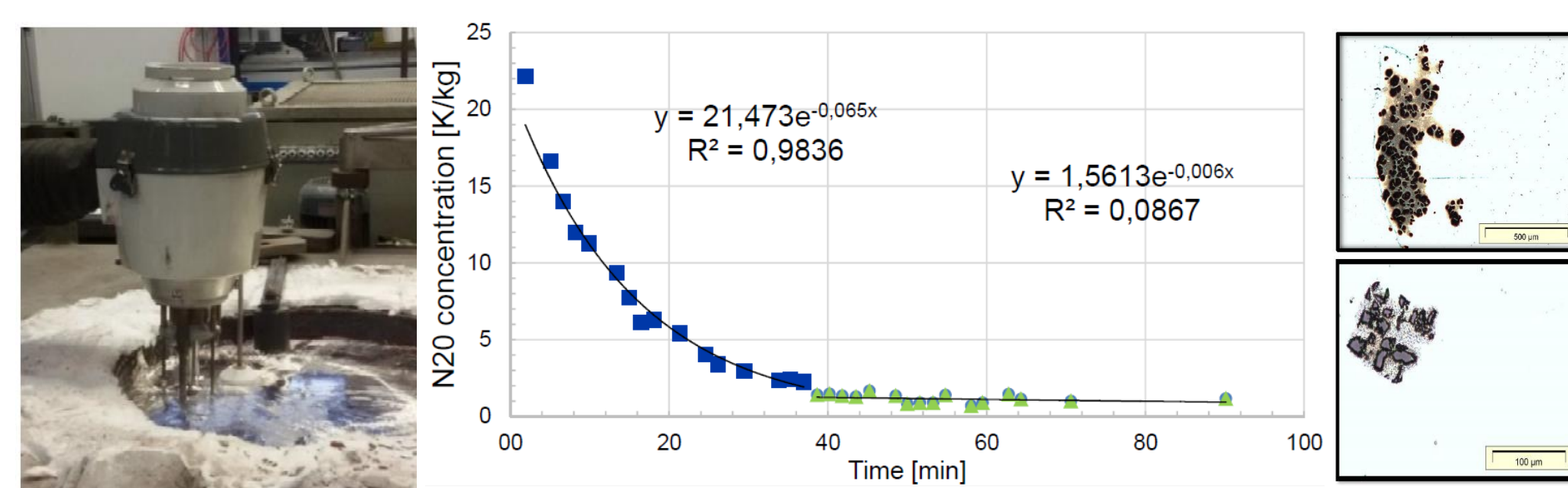
LiMCA setup; Settling characteristics of particles and films; Aggregates of Al_2O_3 and SiC within the Al-melt.

Continuation of P4

Industry partners of P4, FOSECO and MAGMA, will proceed to support the Particle Behaviour research of P4, denoted P4C, in order to enhance the fundamental know-how of inclusion agglomeration. Two following tasks have been jointly decided to be the main research areas in P4C:

➢ Agglomeration study with both unique type and different types of inclusions in 5000 Al-melt;

➢ Inclusion removal experiments (sedimentation and floatation) based on understanding and utilization of agglomeration.