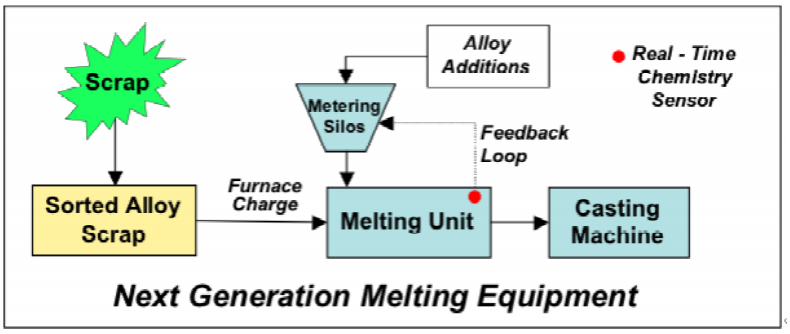
Molten Metal Compositional Sensing to Enhance Scrap Recycling

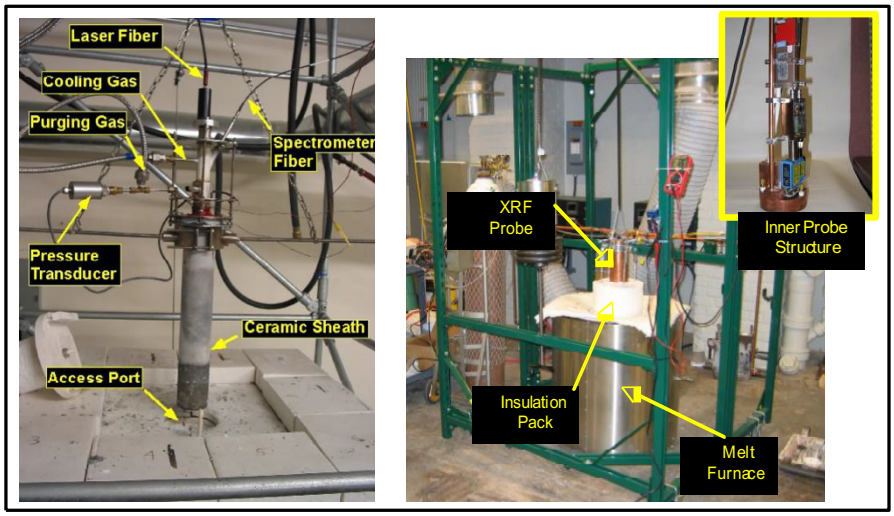
Secondary aluminum smelters have expressed the need for real-time melt compositional sensor such as laser induced breakdown spectroscopy (LIBS) and x-ray fluorescence (XRF) probes. Real time sensing allows faster melt composition correction, avoidance of out-of-spec melts and associated remelt, and encourages higher scrap utilization and greater economic benefit for the retention of domestic scrap.

Compositional sensing also enables direct melting of scrap (without the need for secondary smelting) in casting operations using highly energy efficient continuous melting units, such as are currently in development through DOE funding, see nearby figure.



Schematic illustration of the closed loop continuous melting furnace.

We demonstrated the feasibility of measuring the composition of molten aluminum using two mmersion probes that exploit x-ray fluorescence (XRF) and laser induced breakdown spectroscopy (LIBS), respectively. Both probes, shown in adjacent photographs, interrogate near- surface molten metal located at the bottom of the immersed probe.



LIBS (left) and XRF (right) probes for measuring the composition of molten aluminum alloys.

Earlier work showed that these probes operate stably over long periods of but each probe also exhibited anomalous compositional measurements likely associated with surface segregation. This project studied the cause of melt-surface compositional anomalies and developed probe design and analysis modifications that increased the measurement reliability and accuracy. The project performed two tasks designed to achieve the project objectives; it verified surface chemistry and carried out analyses and experiments to isolate the mechanism and time-scales for the apparent surface segregation, where the second task will modify LIES and XRF probe designs and operational methods to eliminate the cause of measurement inaccuracy.