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 will allow faster melt composition correction, avoidance of out-of-spec melts and associated remelt, and encourage higher scrap utilization and greater economic benefit for the retention of domestic scrap.

Compositional sensing will also enable 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.](image)

Recently, researchers at WPI, wTe Corporation, and ERCo have demonstrated the feasibility of measuring the composition of molten aluminum using two immersion 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.](image)

Earlier work has shown that these probes operate stably over long periods of but each probe also exhibits anomalous compositional measurements likely associated with surface segregation. The project objective is to determine the cause of melt-surface
compositional anomalies and develop probe design and analysis modifications that increase the measurement reliability and accuracy.

This project will involve two tasks designed to achieve the project objective; the first will verify surface chemistry and carryout analyses and experiments to isolate the mechanism and time-scales for the apparent surface segregation, where the second task will modify LIBS and XRF probe designs and operational methods to eliminate the cause of measurement inaccuracy.