MACROSCOPIC X-RAY FLUORESCENCE CAPABILITY FOR LARGE-SCALE ELEMENTAL MAPPING

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A non-destructive method of determining segregation of constituent elements over large length-scales is desired. Compositional information to moderate resolution over centimeters will be powerful not only to validate casting models but also to understand large-scale phenomena during solidification. To this end, we have rebuilt our XRF capability in conjunction with IXRF Systems, Inc. (Houston, TX) to accommodate samples that are much larger than those that typically fit into an XRF instrument chamber: from a few cubic millimeters up to 70 cm x 70 cm x 25 cm. This system uses a rhodium tube with maximum power of 35 kV and 100 μA, the detector is a liquid nitrogen cooled lithium drifted silicon detector, and the smallest spot size is approximately 0.4 mm. Reference standard specimens have enabled quantitative elemental mapping and analysis. Challenges to modifying the equipment will be discussed, and data from samples showing homogeneous distribution and/or heterogeneities over large distances will be presented. Non-uniformities in the Inconel 718 system will be shown and discussed. As another example, segregation of niobium or molybdenum in depleted uranium (DU) castings has been known to occur based on wet chemical analysis (ICP-MS), but this destructive and time-consuming measurement is not practical for routine inspection of ingots. The U-Nb system is complicated due to overlap of the Nb K-alpha line with the U L-beta. Preliminary quantitative results will be shown on the distribution of Nb across slices from DU castings with different cooling rates, plus an examination of Mo segregation within a U-10Mo casting. We foresee this macro-XRF elemental mapping capability to prove invaluable to many in the materials processing industry.