**Grazing incidence X-ray Diffraction (GIXRD) for Characterizing Residual Stress in Large Grained Additively Manufactured Materials**

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Residual stress is a critical factor influencing the mechanical performance and longevity of additively manufactured (AM) materials. Accurate characterization of these stresses is essential for refining manufacturing processes and ensuring the reliability of final components. The sin²ψ method is a widely employed X-ray diffraction (XRD) technique for residual stress measurement due to its sensitivity and precision. However, the irradiated lateral spot size and penetration depth vary with chi and omega angles in this method, which can be problematic for materials with large grains (>100 um), a common characteristic in AM materials. Large grain size means that fewer grains contribute to the diffraction peak. This leads to low peak intensities and less accurate determination of the peak position resulting in a reduction in accuracy of stress measurements taken in conventional sin²ψ geometry.

To address these limitations, this research explores the potential of using grazing incidence X-ray diffraction (GIXRD) as an alternative method for characterizing residual stress in additively manufactured materials, particularly those with large grain structures. GIXRD offers the advantage of irradiating a much larger surface area at a fixed incidence angle (omega), therefore measuring stresses across several grains and with constant penetration depth which could lead to a more representative measurement of residual stress in a large-grained material.