Preliminary Experiment for Residual Stress Analysis at APS

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It is well known that no material or component is free from residual stress. As a practical matter, residual stress can have both detrimental and favorable consequences on the behavior of materials. Sufficient information on residual stress is of particular interest to engineers and designers in many fields for selecting reliable materials and components. However, at present our knowledge of residual stress has much room for improvement. Therefore reliable experimental methods for residual stress determination are of great practical importance. Among the commonly used methods, X-ray diffraction is one of the most promising methods. Especially with the development of third generation synchrotron radiation facilities, more reliable residual stress measurements are expected. In order to evaluate and find the proper conditions for residual stress measurement at the Advanced Photon Source (APS), two kinds of preliminary X-ray diffraction experiments were conducted: 1.) Angle dispersive X-ray diffraction (ADXD) on beamline 12BM and 2.) Energy dispersive X-ray diffraction (EDXD) on beamline 15ID. In this report, these two experiment methods and their precision are introduced and compared. The results with and without the use of an analytical crystal are compared for the ADXD method. Also, the many factors that may influence the accuracy of the experiments are discussed; i.e. the displacement of samples surface, fluorescence, energy calibration etc.

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