# PREDICTING FATIGUE FAILURE USING TWO DIMENSIONAL X-RAY DETECTORS

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The fact that cold work will broaden a diffraction ring due to small particle size and strain is well known, however, no published reports have quantified the amount of broadening that will occur at the various steps of "work" leading to failure. In essence developing a fatigue sensor that will predict failure.

This paper discusses how x-ray diffraction rings change as a function of "cold work" for various materials. For example an as drawn wire will have fairly large crystallites of a given material. These crystallites will also be textured about the diameter of the wire. Diffraction rings taken of the wire using a two dimensional detector will show a spotty diffraction ring. As the wire is fatigued toward its elastic limit the crystallites will become smaller and less textured. In turn this will cause the diffraction ring to broaden and become less spotty. Earlier work using film techniques have measured mean particle size and grain misorientation from the number and shapes of the diffraction "spots" respectively. A microdiffractometer utilizing capillary optics is used to analyze small areas and an area detector enables us to collect the data in two-dimensions. The degree that the diffraction rings change as a function of work leading to failure can be determined for several materials. Models can be developed for each material type. In turn these models can be used to determine how close to failure a material is by simply collecting diffraction rings and comparing to the model.

Current technology will not detect failure until small cracks occur. In essence the failure has already occurred. We will demonstrate how failure can be predicted prior to actual failure of a given material such as copper wire and aluminum plate.

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