The powder diffraction method has an exceptionally broad range of applications owing to its relative ease of use and its applicability to any crystalline material. Furthermore, powder diffraction can access a considerable breadth of sample characteristics: qualitative and quantitative phase analysis as well as crystal- and micro-structure determinations. Each application presents a specific challenge with regards to the development of a standard, both in the context of the character of the standard itself and the method by which it is certified.

The overall technical approach can be divided into a few subtopics: 1) microstructure engineering and/or evaluation to obtain SRM feedstock suitable to address the measurement issue at hand, 2) the design and commissioning of the equipment that embodies the unique features required for SI traceable measurements, and 3) the design of experiments, measurement methods and data analysis strategies that allow for a valid assessment of systematic uncertainties of the measurement quantities. A last component of the program entails the examination of the techniques and data analysis methods by which SRMs are used for the calibration of instruments in the field.

The success of an SRM is often dependent on obtaining a feedstock of the appropriate microstructure. Several years were expended to develop the preparation process used for the feedstock of the new nano-crystallite size SRM 1979. The process that was used consisted of the decomposition of zinc oxalate in a custom NIST-built vacuum furnace to yield two powders; one with a crystallite size centered about 15 nm and a second one with a mean diameter of 60 nm. We have now collected two sets of data on this material on a machine equipped with an incident beam monochromator and either a fixed slit and scintillation detector or a silicon-strip position sensitive detector. We will present the data analysis from this material, showing how a combination of the fundamental parameters approach and extraction of the Fourier transforms of isolated peaks allows computation of the necessary parameters in Fourier space, where the detailed theory for particle size distributions is derived.

Recent line position SRMs, as has been previously reported, have been certified with respect to lattice parameter in an SI traceable manner using the NIST-built divergent beam diffractometer. While this divergent beam diffractometer includes several unique features that enable it to provide SI traceable measurements, we have also commissioned a parallel beam diffractometer that includes additional features which will yield measurements with reduced error bounds. We have now realized calibration of the optical angular encoders on this machine; with the determination of both short range and long range corrections, to yield an angular measurement accuracy of $\pm 0.035$ arc-seconds. We also report on the results of a double crystal experiment that was successfully used to examine the Cu $K\alpha$ emission spectrum. This experiment will be repeated after the graded parabolic optic is installed as it is known that this optic distorts the spectrum to some extent.