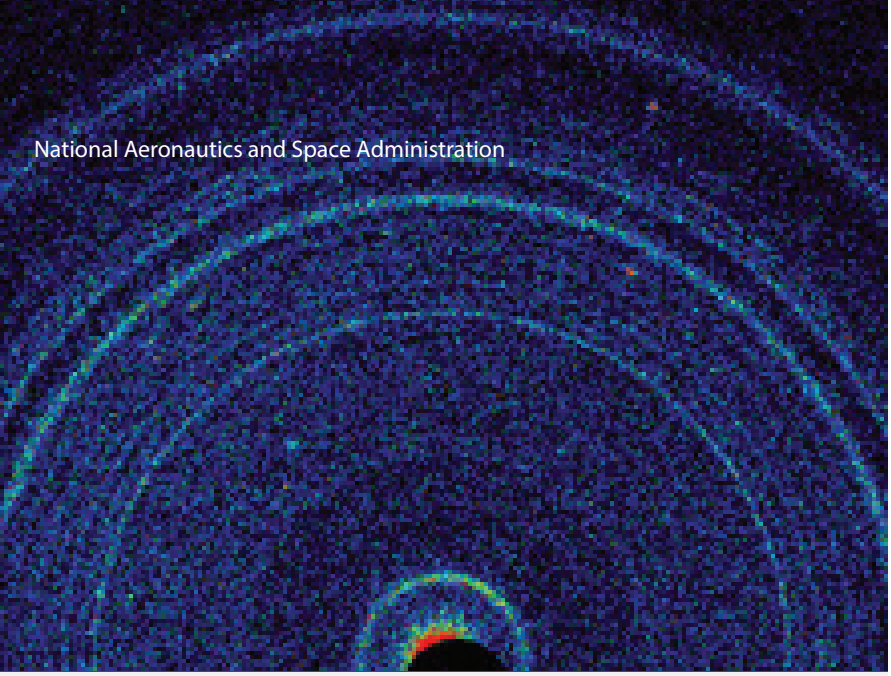

Instrumentation

Powder Handling Device for Analytical Instruments

A sample handling and movement system

A new NASA technology provides for automated sample handling and movement of coarse-grained powder or other solid materials to enable analysis by a robotic or totally automated computer system. Currently, many analytical instruments require a powder sample: to control the shape and/or volume of the specimen; to increase the surface area of the specimen; to increase the statistical representation of a specimen when samples are not homogeneous with regard to the characterized property; and/or to increase the statistical representation of the specimen spatial orientation when the properties being characterized are not equivalent in different viewing directions. Grinding the material down to an ideal grain size is sometimes impossible, and conditioning the sample for analysis is often time consuming and labor intensive. In the new approach described herein, the powder is handled as a fluid, using mechanical vibrations in conjunction with a driving force (gravity or gas flow) and requiring few or no moving parts. This invention is available for licensing from NASA's space program to benefit U.S. industry.

BENEFITS

- Relaxes constraints on longstanding requirement for fine grained powder for XRD analysis
- Totally automated
- Remotely operated XRD/XRF
- Improved quality of solid/powder analysis
- Improved quality of the analysis by randomly rotating the grains of powder to expose all orientations to the detector
- Isolation of the sample from the environment to safely analyze reactive or dangerous material
- Simple and suitable for in situ applications
- Adjust density or compactness of the powder

technology solution

THE TECHNOLOGY

This invention is a system and associated method for causing a fine-grained powder in a sample holder to undergo at least one of three motions (vibration, rotation or translation) at a selected motion frequency in order to expose a statistically relevant population of grains in random orientation to a diffraction or fluorescent source. One or more measurements of diffraction, fluorescence, spectroscopic interaction, transmission, absorption and/or reflection can be made on the sample, using x-rays or light in a selected wavelength region. In one embodiment, the invention allows the relaxation of sample preparation and handling requirements for powder X-ray Diffraction (pXRD). The sample, held between two thin plastic windows, undergoes granular convection similar to a heated liquid, causing the individual grains to move past a collimated X-ray beam in random orientation over time. The result is an X-ray diffraction pattern having the correct diffracted intensities without a requirement for specialized mechanical motions. A major improvement over conventional sample preparation and handling techniques for pXRD is the potential to characterize larger grain-size material, resulting in a significant relaxation of the constraints on sample preparation (grinding). The powder handling system as described extends the range of useful grain sizes for XRD/ X-ray fluorescence (XRF) from a few micrometers (μm) to several hundred μm. Inclusion of the powder handling system enables automated instruments such as CheMin, a robotic XRD/XRF instrument designed and developed by NASA, to analyze as-received or coarsely powdered samples on NASA's Mars Science Laboratory rover, or in extreme, toxic or hazardous environments on Earth.

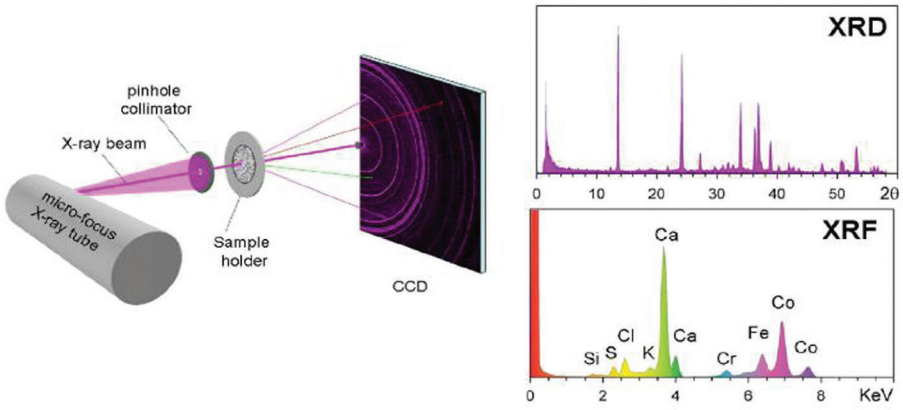

FIGURE – Geometry of the CheMin instrument. (left) Overall geometry of CheMin; (above right) XRD 2-theta plot obtained by summing diffracted photons from either of the characteristic lines of the X-ray source (Co K-alpha is colored magenta); (below right) X-ray energy-dispersive histogram obtained by summing all of the X-ray photons detected by the CCD (fluoresced photons from the sample shown schematically for elements Fe and lighter).

APPLICATIONS

The technology has several potential applications:

- Geology and mineralogical analysis – from Earth or other planets
- Pharmaceutical and biochemistry industry
- Laboratory XRD and/or XRF analysis for samples that do not qualify as "fine"
- Industrial and mining materials
- Homeland security
- Archaeology
- Specimen analysis

PUBLICATIONS

U.S. Patent 7,113,265

ARC-15101-1

"Vibrating sample holder for XRD analysis with minimal sample preparation." 2005

IN: Advances in X-ray Analysis, 48 pp. 156-164.

More Information

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