

CheMin

Group-2

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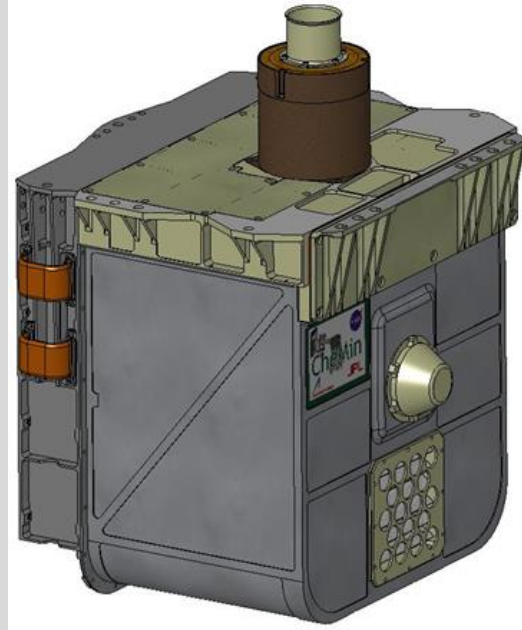
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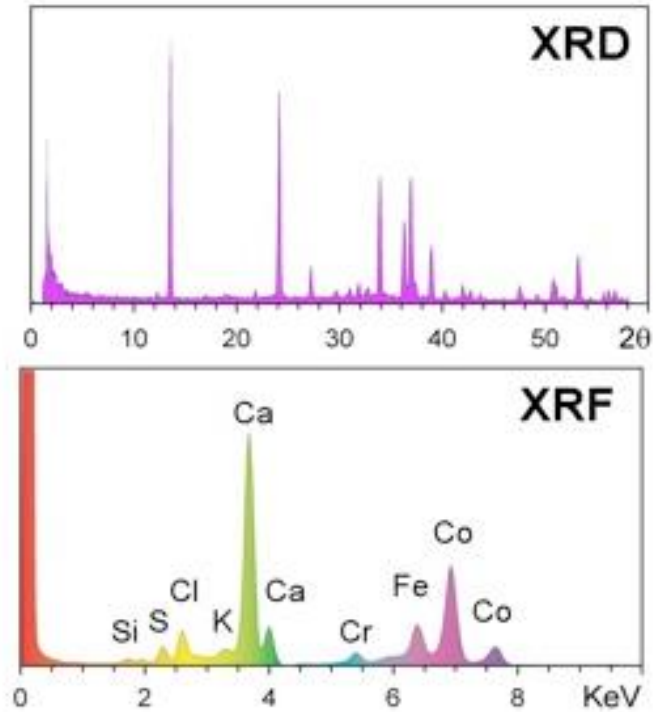
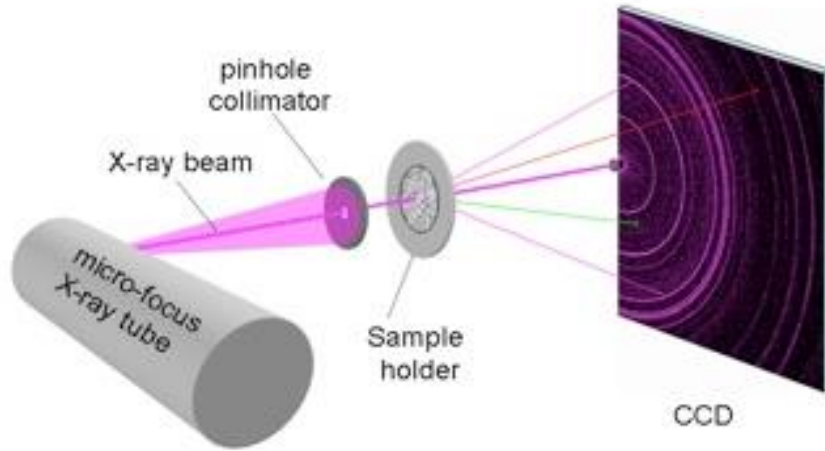
Introduction

- ❖ CheMin is a mineralogy instrument that will identify and quantify the minerals present in rocks and soil powder samples delivered by the rover's robotic arm



Description

- ❖ CheMin Instrument is located inside the main body of the rover
- ❖ CheMin Uses
 - A technique called X-ray diffraction (XRD) for mineralogy characterization
 - X-ray fluorescence (XRF) for elemental characterization
 - A single detector for both measurements
 - One moving part (Sample wheel)



(CheMin XRD/XRF instrument)

What CheMin does?

- ❖ CheMin analyze the sample delivered to it by SA/SPaH
- ❖ It identifies the minerals present in Mars soil & rocks
- ❖ Mineralogy helps CheMin to assess the involvement of water in their formation, position and alteration
- ❖ CheMin data is useful in the search for potential mineral energy sources for life or indicators for past habitable environments

CheMin Requirements

❖ Power Requirements

- Chemin require 250W-hr power per evening for processing.
- CheMin is limited to approximately 4 hours of analysis per evening of operation, with the remaining energy allocated for pre-analysis warm-up of the X-ray source, and post-analysis data processing and transfer.
- The complete analysis of any one sample can take up to 10 hours, thus requiring multiple evenings to analyze a sample.

CheMin components

❖ Funnel

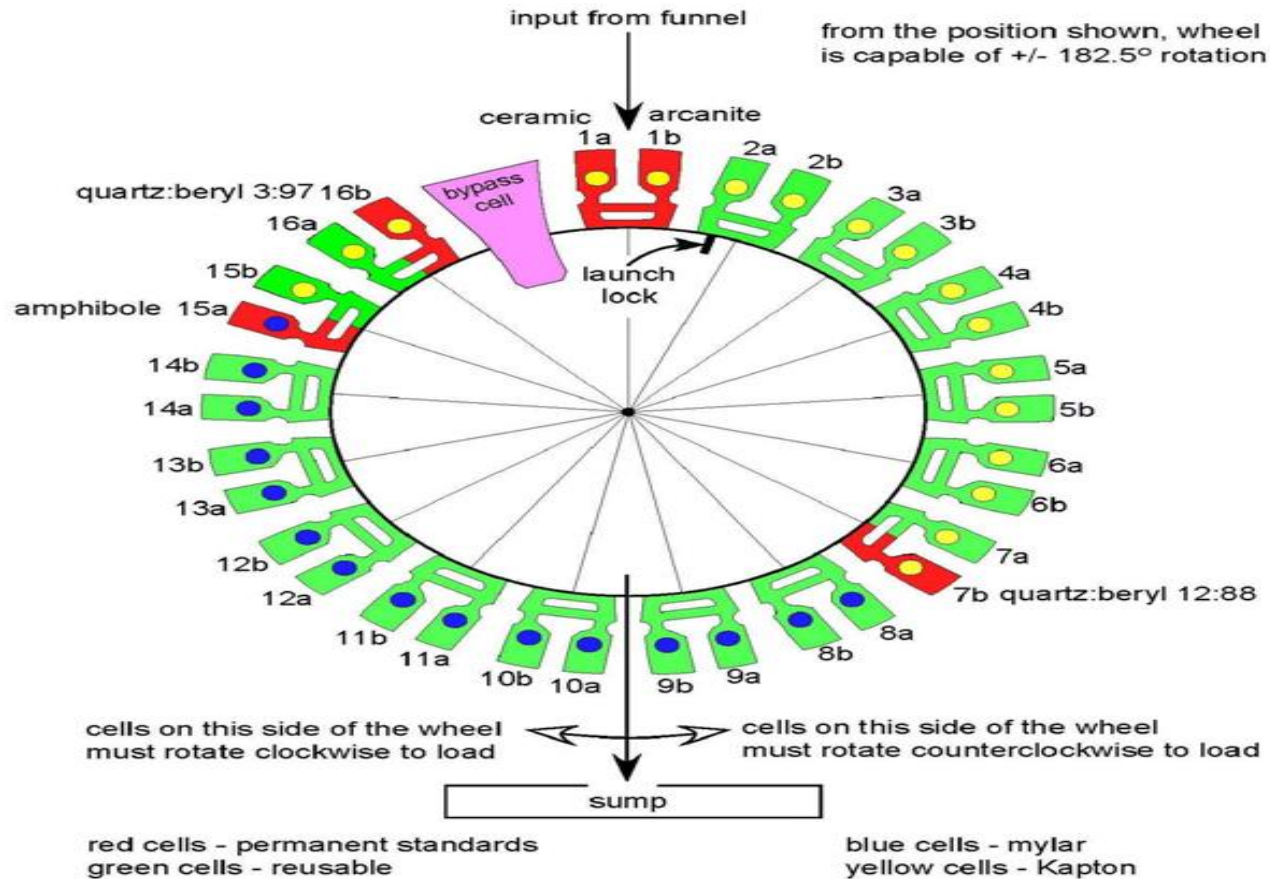
- Receives drill powders or scoop samples from the SA/SPaH system
- Maximum of 65 mm³ of sample material is delivered
- It contains a 1-mm mesh screen to keep larger than expected grains from entering the CheMin sample handling system
- Grains that pass through the screen will pass into the upper reservoir portion of the sample cell
- CheMin may reduce contamination by sample dilution

CheMin components

❖ Sample cell and sample wheel

- Carries 27 reusable sample cells and 5 permanent reference standards
- Only 10 mm³ material is required to fill the sample cell
- Remaining sample goes to reservoir (which is above cell)
- During filling, analysis, and dumping, the sample cell is shaken by piezoelectric actuators (piezos)

CheMin sample wheel - view from the side toward the X-ray source



(Sample Wheel And Sample cell)

CheMin components

❖ X-Ray Beam

- X-ray beam from the X-ray tube is directed through a transmission sample cell containing sample
- X-ray sensitive CCD imager is positioned on the opposite side of the sample from the source
- X-ray diffraction occurs with the crystal material and form the rings i.e. a two-dimensional image that constitutes the diffraction pattern

CheMin Process

❖ CONFIG PHASE

- Position the X-ray sensitive CDD imager
- Receive drilled powder through the drill, scoop and CHIMRA sorting assembly

CheMin Process

❖ FILLING PHASE

- Open chemin inlet protection cover
- 16 dual cells on the sample wheel -> 1piezzo for each dual cell
- piezzo is active during filling analysis and dumping
- Turn on piezoelectric actuators number X
- put sample in the funnel
- Close inlet protection cover

CheMin Process

❖ ANALYSIS PHASE

- Turn on X-ray beam
- CDD reads out and erase the X-ray flux multiple times (+1000times) for analysis
- Data handling
- Identify energy of X-rays strikes by the detector and produce 2D image of diffraction pattern
- Sum all the X-ray detected by CDD into a histogram of number of

CheMin Process

❖ DUMPING PHASE

- Rotate the sample wheel 180^0 (sample cell inversion)
- Empty the cell after use by inverting and vibrating the sample cell over the sump
- Rotate back to the next sample slot
- Rotate the sample wheel 180^0-X (X corresponds to the distance between sample cells)
- Turn off piezzo

CheMin Commands

- ❖ chemin on: start the chemin process
- ❖ xray_set_position: set the xray position towards sample
- ❖ sample_receive: this message from telecommunication module
- ❖ cell_next: from the sample
- ❖ cell_clean_current: dump the sample
- ❖ inlet_open: open the
- ❖ inlet_close:

CheMin Commands

- ❖ `xray_turn_on`: turn on the x-ray beam
- ❖ `analysis_start`: start analysis on sample
- ❖ `cdd_create_diffraction_image`:
- ❖ `cdd_create_1d_2t_plot`:
- ❖ `send_result`: send result to telecommunication server
- ❖ `power_off`: turn off the chemin and terminate the process.

Code Explanation

❖ SimulateRoverMain

➤ Module creation

- CheMinModuleMain
- Power Server
- Telecom Server

➤ Module launching

- CheMinModuleMain is launched
 - Threads for CheMin server and CheMin process are created & started
- Server threads for Power and Telecom are created & started

Code Explanation

❖ CheMin server

- If message is 'chemin_on'
 - Set CCU to true and create CheminClient(9013->power) thread and start it
- If message is 'power on'
 - Launch chemin process create CheminClient(9002->Telecom) thread and start it
- If message is 'Power Off'
 - Then free Chemin threads

Code Explanation

❖ CheMin Client

➤ If port is 9013

- PowerRequirement is sent to PowerClient

➤ If port is 9002

- XrdDiffraction image is sent to TelecomClient

Code Explanation

- ❖ CheMin Process - can receive the text file which contains the commands to execute
 - `f_xray_set_position()`
 - set and configure x-ray beam position
 - `f_sample_receive()`
 - launch the powder sample receiving procedure
 - If inlet cover is opened, abort the operation

Code Explanation

➤ `f_cell_go_to(5)`

- Choose the sample cell (depending on given sample cell number and current sample cell)

➤ `f_cell_clean_current()`

- Start the cleaning procedure

➤ `f_inlet_open()`

- Open inlet cover if not opened already

Code Explanation

➤ `f_piezzo_tun_on(v_current_sample_cell/2)`

- Turn on the given piezzo if not on

➤ `f_inlet_close()`

- Close inlet cover if not closed already

➤ `f_piezzo_turn_off(v_current_sample_cell/2)`

- Turn off the given piezzo if not off

➤ `f_xray_turn_on()`

Code Explanation

➤ `f_analysis_start()`

- Verify that every component is ready to start analysis phase
 - X-ray position
 - X-ray on
 - Inlet cover closed
 - Sample cell contamination checked
 - Sample not contaminated

Code Explanation

➤ `f_analysis_start()`

- Starts analysis

- play music 'voice.mp3'
- `f_cdd_read_erase()`

Code Explanation

➤ `f_cdd_create_diffraction_image()`

- Create diffraction image

➤ `f_cdd_create_1d_2t_plot()`

- Create 1D 2theta plot image

➤ `f_send_results()`

- End of process, send results to telecom

Code Explanation

❖ Power Server

- Waits for client message
- If receive message, print it
 - then create power client(9008->CheminServer) thread and start it

Code Explanation

❖ Power Client

- Print socket port
- If socket port is 9008
 - then send "POWER ON" to port 9008 (to Chemin Server)

Code Explanation

❖ Telecom Server

- Waits for client message
- If receive message print it
 - then create telecom client(9008->CheminServer) thread and start it

Code Explanation

❖ Telecom Client

- Print socket port
- If socket port is 9008
 - then send "Chemin receives telecom acknowledge" to port 9008 (to Chemin Server)