Dehydration of Calcium Sulphate Dihydrate using X-Ray Photoelectron Spectroscopy(XPS) and Raman Characterization

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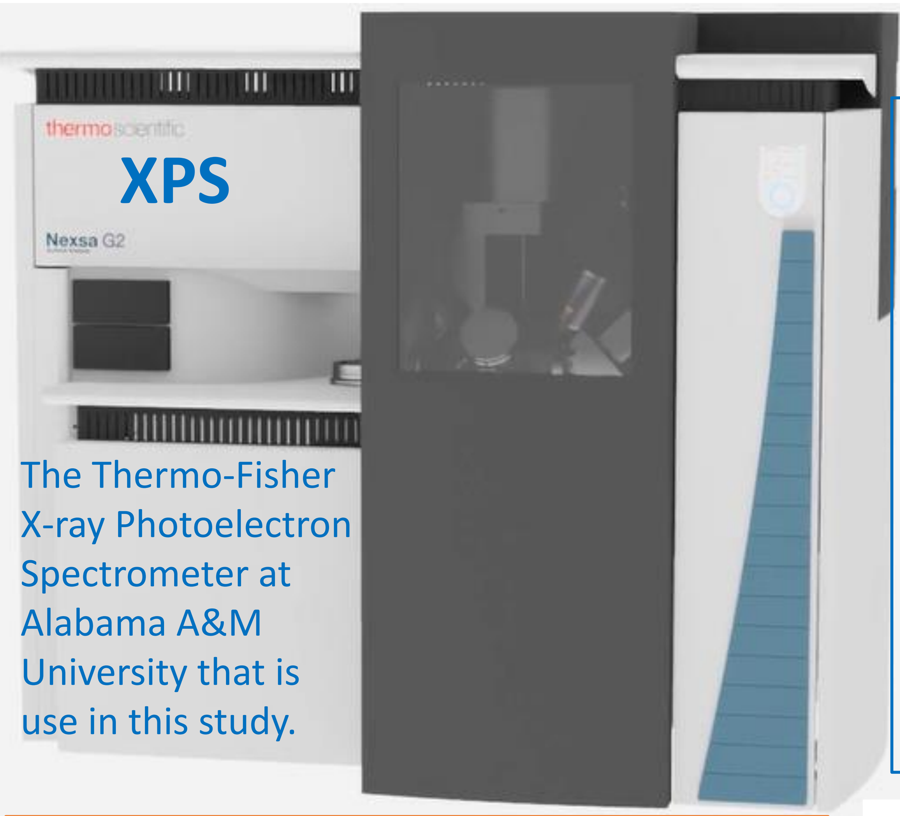
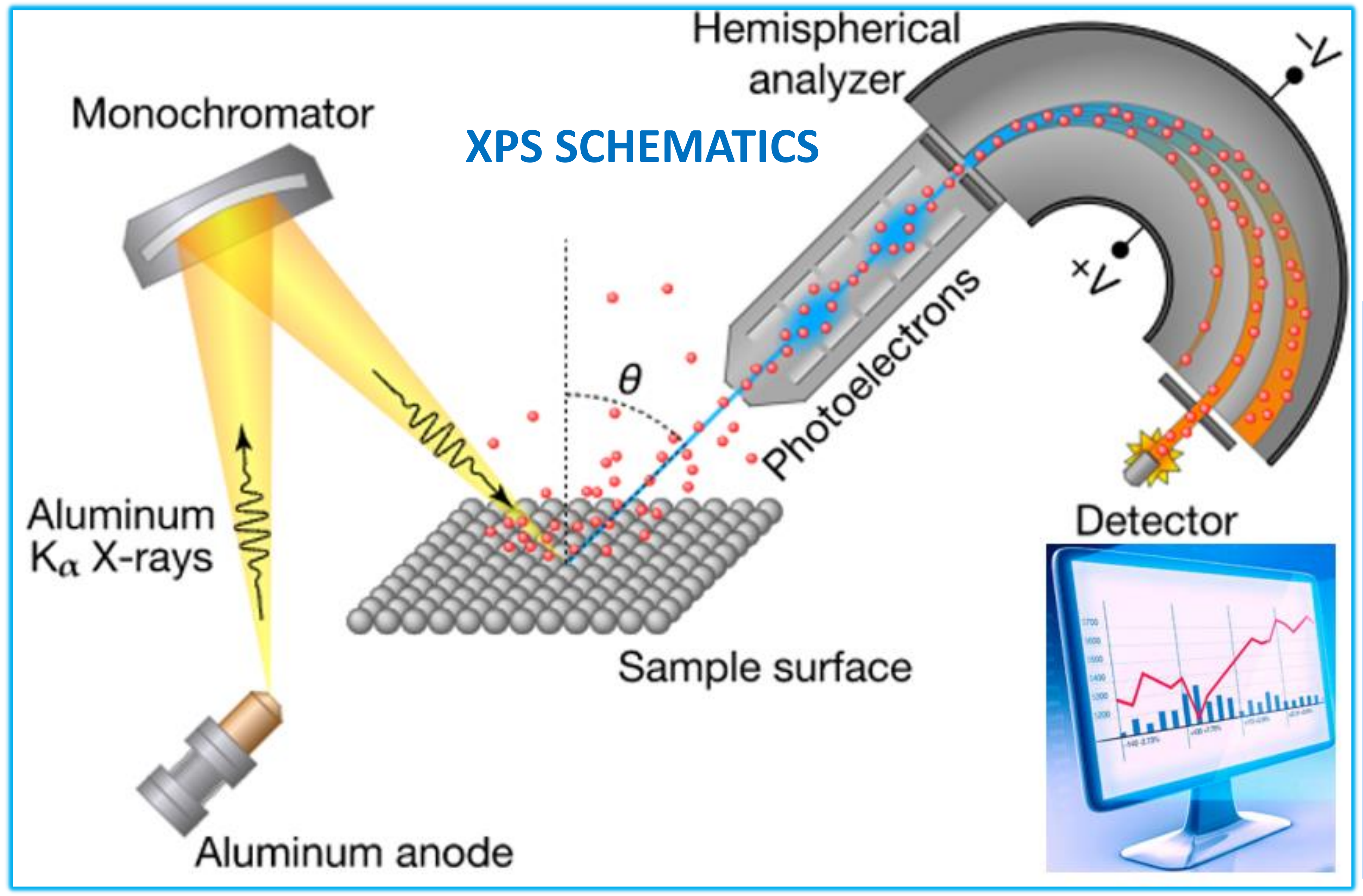
INTRODUCTION

Calcium sulphate dihydrate $CaSO_4.2H_2O$, known as gypsum, can change to calcium sulphate hemihydrate $CaSO_4.\frac{1}{2}H_2O$, also known as bassanite, when it is put into the furnace over a period. The temperature used was at a constants 140^oC for over two hours. The transformation of the gypsum to bassanite is mainly due to the time the raw material $CaSO_4.2H_2O$ undergoes the dehydration process. Staying longer in the furnace could lead to anhydrate of $CaSO_4$. When higher temperatures were applied, it also took close to about the same amount of time for transformation to occur. Thus, temperatures higher than 140^oC will not have much effect in the process.



ABSTRACT

Accomplishing hemihydrate and possibly anhydrate from dihydrate is a process that requires both time and temperature. Raman Spectroscopy shows how the dehydration diffusion process affects the compound, while the X-Ray Photoelectron Spectroscopy(XPS) shows how the surface composition of the compound's dehydration process, affect each element.

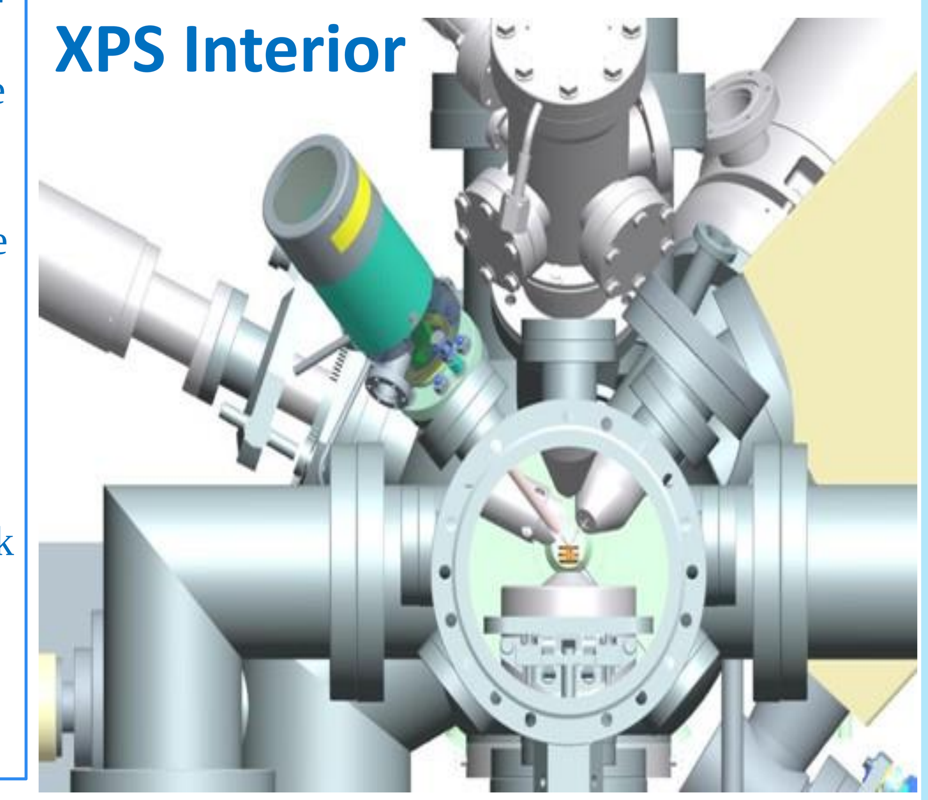


APPLICATIONS

There are several things that it can be used for in the real world. It can further undergo process, that will allow it to be used as a heat shield for thermocouple, to allow temperature reading in places that are extremely hot or that are over 1100^oC. Application also extends to protecting planetary reentry vehicle, from burning and to protect the equipment, samples, and collected data, that are on board, from overheating whenever the shuttle is entering a planet from space. All this applications can be attained, because while the temperature is high or low, it will take considerable amount of time for calcium sulfate to undergo a phase change.

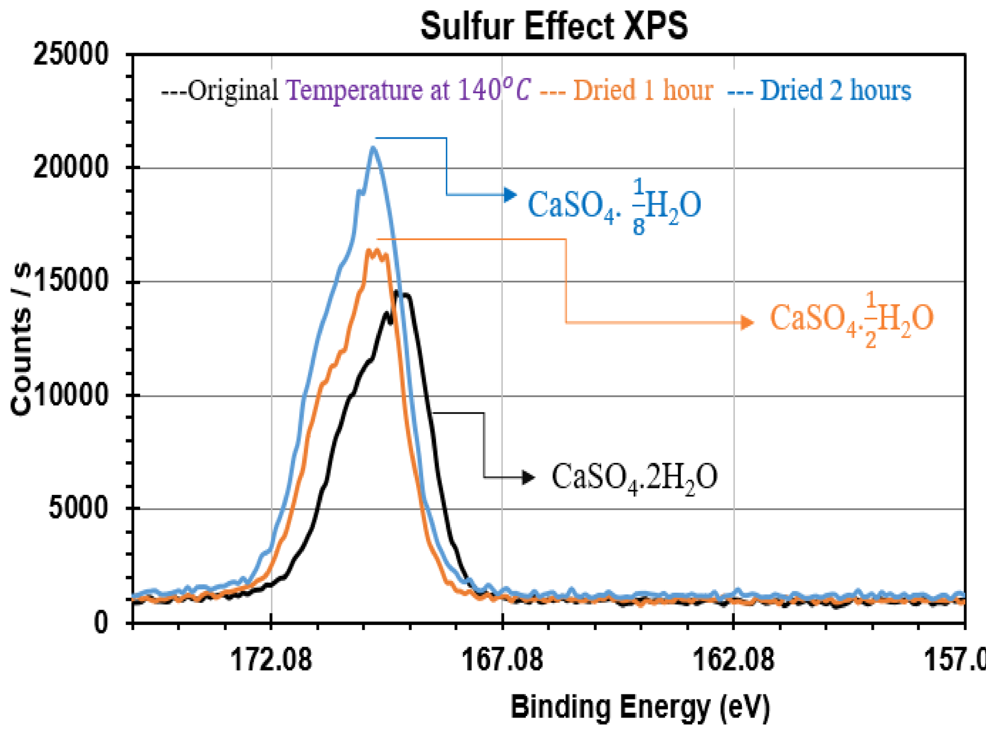
METHODS AND OBJECTIVE

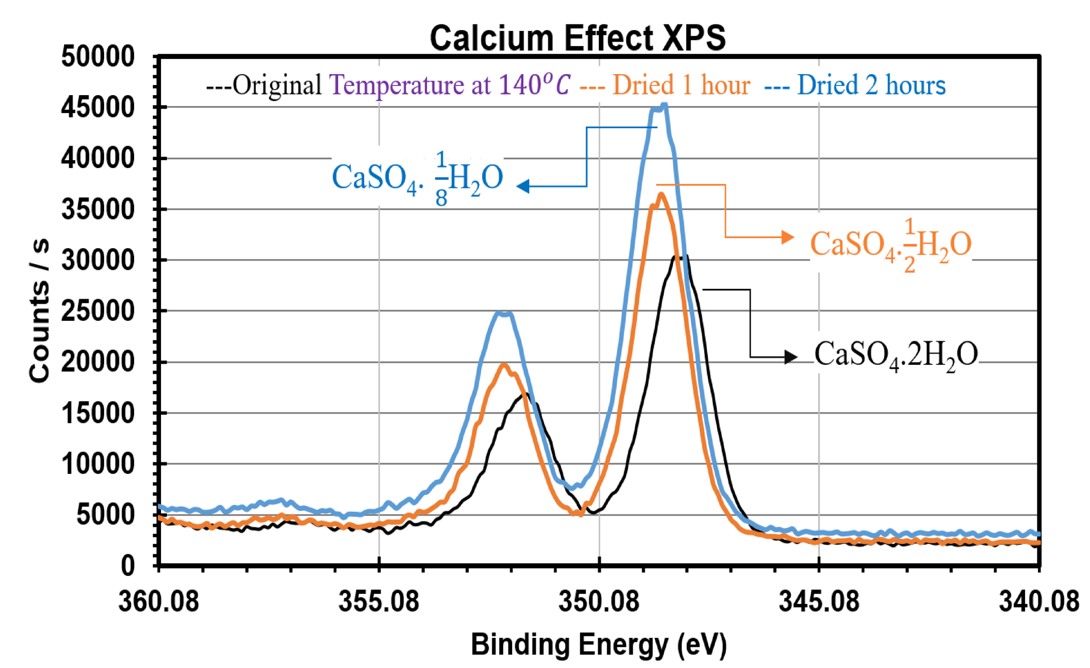
Sample of $CaSO_4.2H_2O$ was put in the ampule. Excessive particles were removed as not to cause contamination. It was put in the furnace after setting it at temperature of 140^oC. It was then dried for one hour. Then it was placed in the X-Ray Photoelectron Spectroscopy(XPS) and Raman Spectroscopy for analysis and characterization. It was then put back in the furnace to further dehydrate for another hour. It was taken for second section of analysis and characterization.

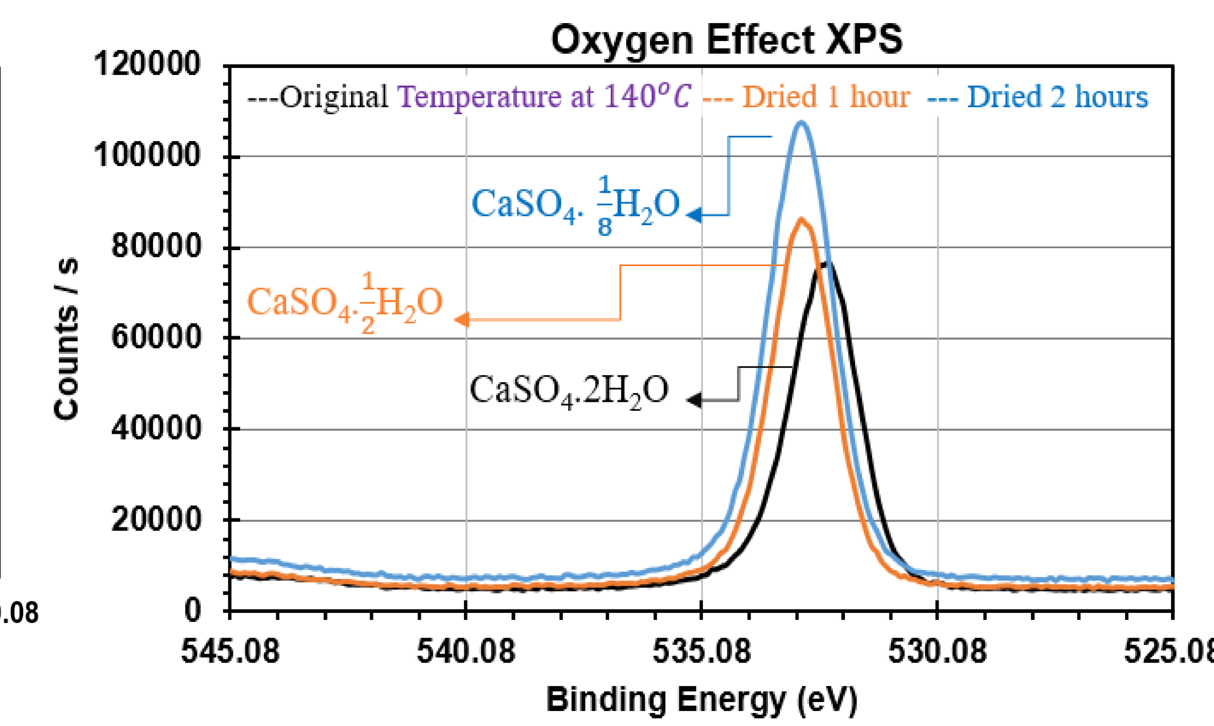


RESULTS AND DATA

The results and data collected are shown in these graphs. The Raman Spectroscopy shows that the H_2O molecule, has moved towards a higher Raman shift, after heating the raw material for over 1 hour. This means that $CaSO_4.2H_2O$ has undergone changes, turning into what is now $CaSO_4.\frac{1}{2}H_2O$. While the X-Ray Photoelectron Spectroscopy(XPS) shows that each element on the surface has attained a higher binding energy level (electron volts eV), due to the reduction in H_2O, we can read that there is a binding energy shift in the peak of Calcium, Oxygen, and Sulfur, after one hour.







CONCLUSION

Gypsum undergoes dehydration to accomplish bassanite. The more time it spends under-going the process, the more likely it will turn into the anhydrous state. While it is in the $CaSO_4.\frac{1}{8}H_2O$ state, it can be reversed, and undergo hydration process towards dihydrate. This has a greater chance of happening at lower damp temperature over a long period of time. The color changes to the sample during dehydration or hydration is almost not noticeable. Only time determines whether it undergoes transformation after it is at temperature of 140^oC.

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SPINS
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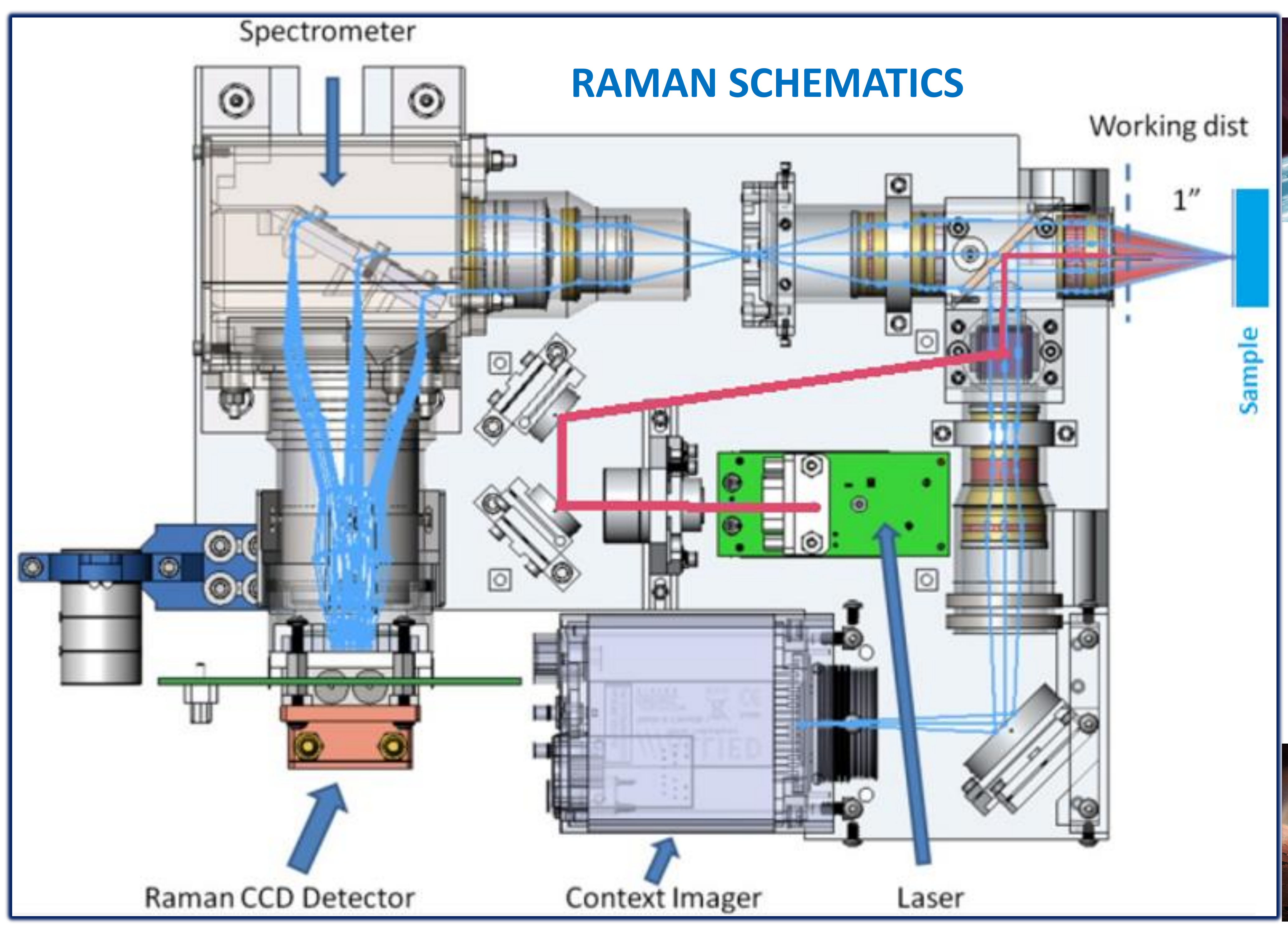
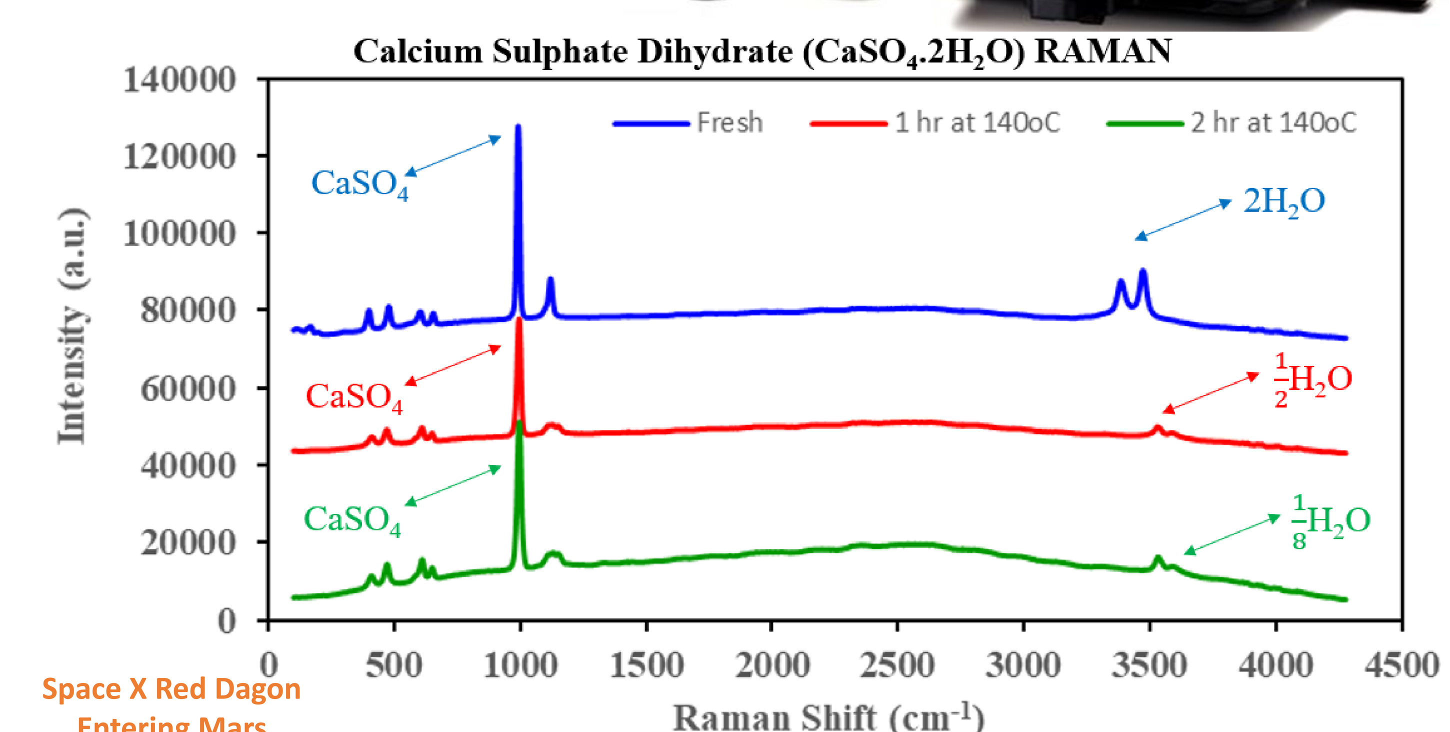
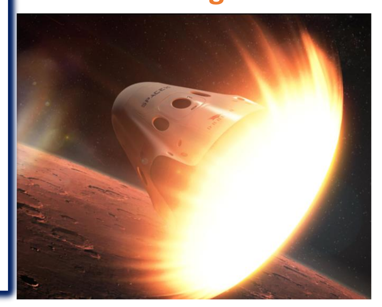


Space Vehicle Re-Entry





Space X Red Dagon Entering Mars