Workshop on Tritium Control and Capture in Salt Cooled Fission and Fusion Reactors

Salt Lake City
10.27.2015 & 10.28.2015

Experimental Work on Hydrogen Transport Analysis in Flibe-Graphite System

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Research Topic 1: Matrix Graphite Characterization

Goal: 1) To study matrix graphite microstructures– **density, porosity, pore distribution, specific surface area, graphitization, etc**; 2) To understand the difference between matrix graphite and nuclear graphite

Graphite Characterization	
Property	**Technique**
Density	Apparent Density
	Gas Pycnometer
Porosity	Numerical Calculation
	BET(Nitrogen)
	Matlab Image Analysis
Pore Distribution	Mercury Porosimetry
Surface Area	BET(Nitrogen)
Graphitization (d_{002})	X-ray Diffraction
In-plane Crystalline Size(nm)	Raman
Other Techniques	SEM
	Optical Microscopy

Research Topic 2: Static Salt Infiltration into Graphite

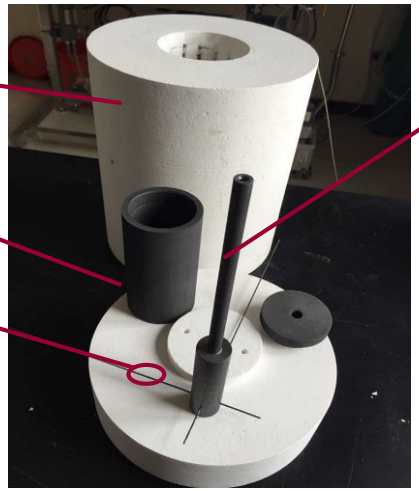
Goal: 1) to investigate salt infiltration process in graphite 2) to understand how graphite salt interaction will affect Fluoride-salt purity

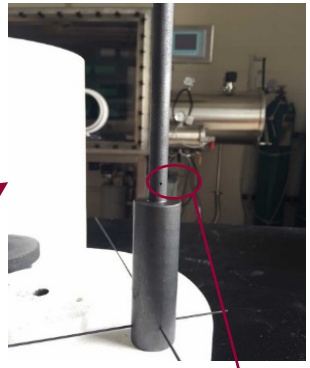
Experimental Setup

Vertical Furnace

Graphite Crucible

Sample Holder





Pressure Release Hole

Sample (1200 grit polished & DI water ultrasonic cleaned)

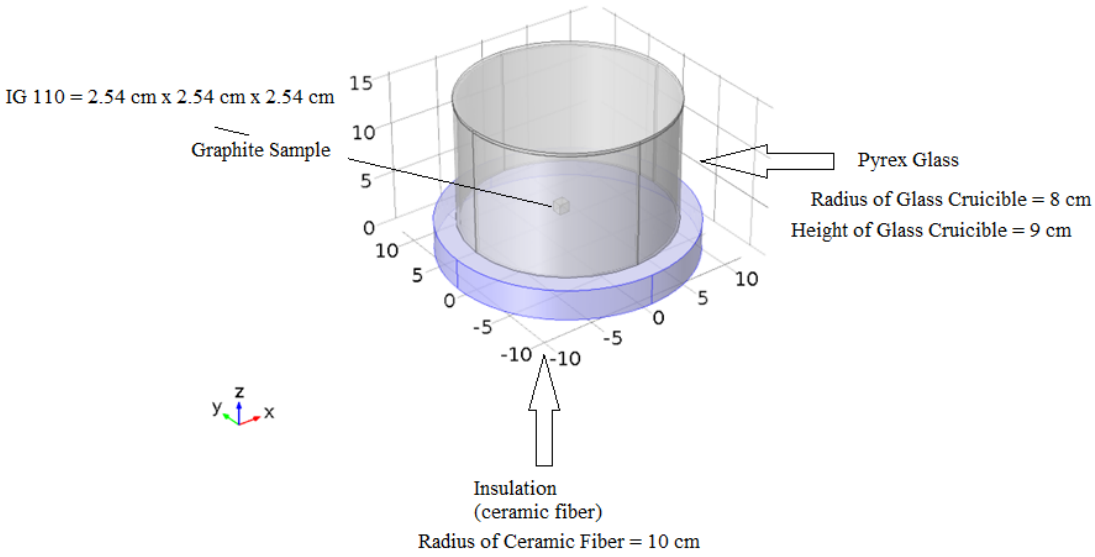
NG: 0.0915g

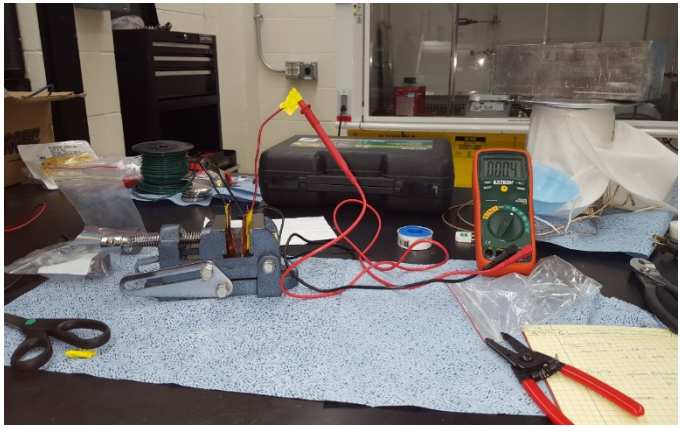
MG: 0.0477g

Research Topic 3: Contact Angle Measurement-Jayeesh

Goal: 1) to investigate whether surface interaction between graphite and flibe will affect flibe intrusion in graphite

Experimental Setup





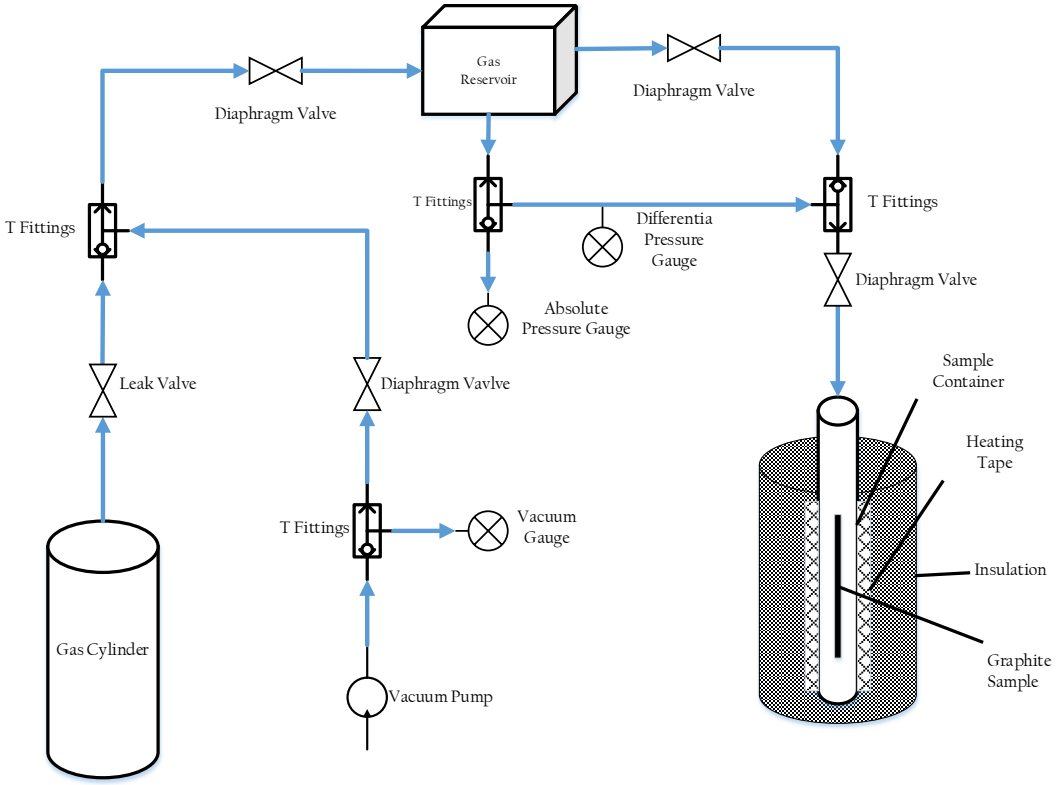
Resistance Analysis

Resistance Measurements of IG-110 Samples					
Sample No	Length (inches)	Width (inches)	Resistance (Ω)	Resistivity (Ω inch)	Resistivity (Ω meter)
1	1.297	1.3082	0.4	0.4328	1.099×10^{-2}
			0.4	0.541	1.374×10^{-2}

Research Topic 4: Hydrogen-Graphite Experiment (Constant Volume Method)

Goal: 1) to study hydrogen isotope transport phenomena in matrix graphite 2) to help to study hydrogen behavior in flibe-graphite system in the future (saturation-limited or diffusion-rate-limited)

Constant Volume Method



Questions to be Answered

o Graphite Characterization:

- Q 1: What physical properties are important for characterizing tritium transport?
- Q 2: The effect of hydrogen baking & oxidization of graphite?

o Flibe Intrusion Experiment

- Q1: Will salt have significant intrusion for modern graphite?
- Q2: Any other post experiment measurements is recommended?

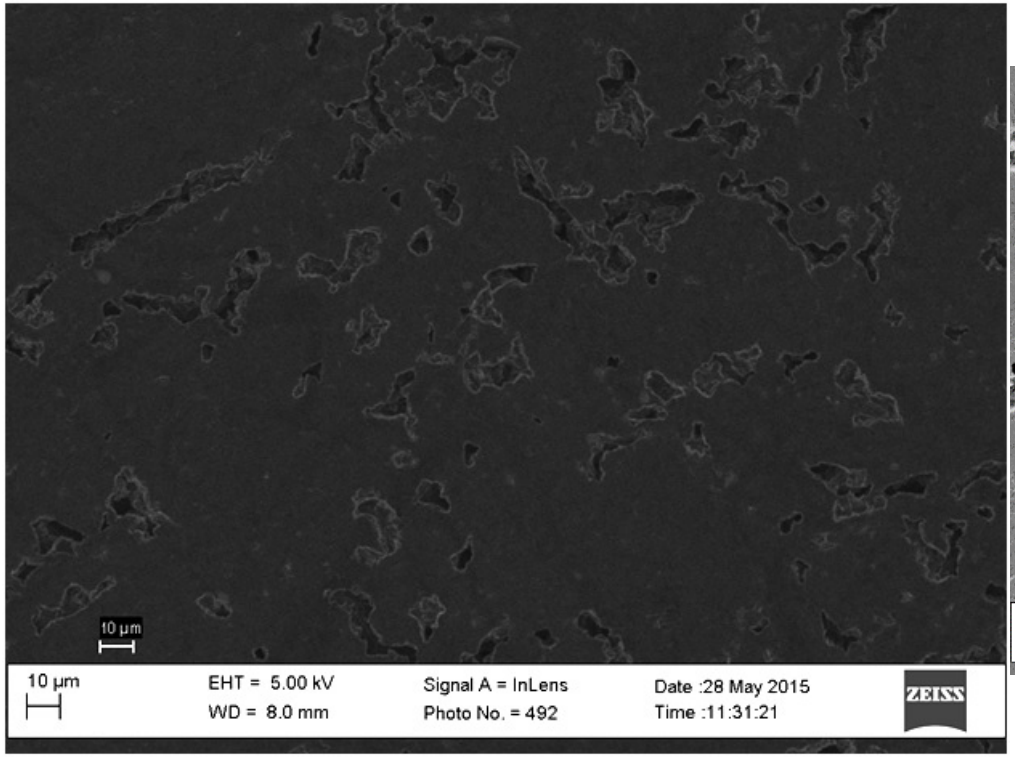
o Hydrogen-Graphite Experiment

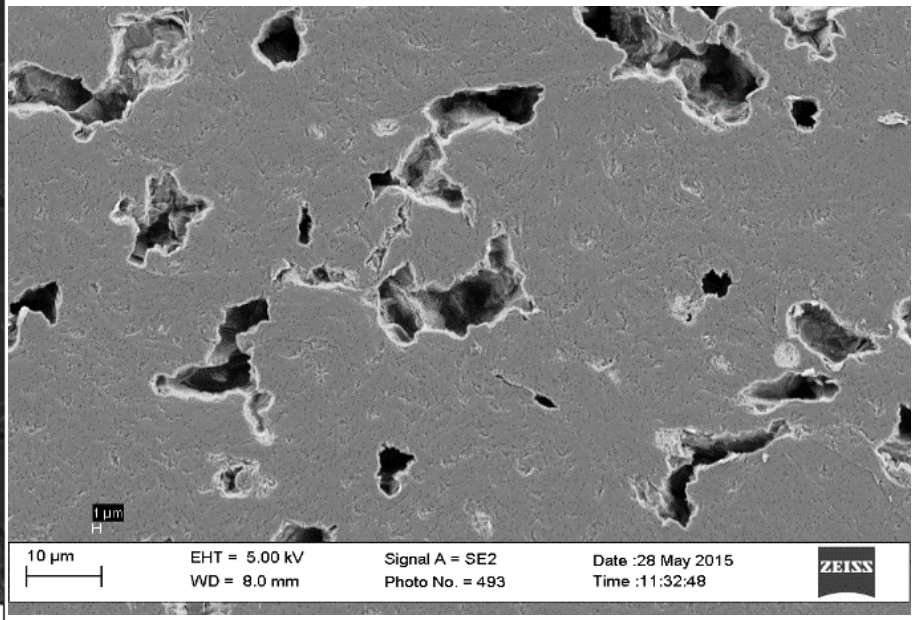
- Q 1: Hydrogen leak problem through the whole system?
- Q 2: Total hydrogen and hydrogen depth profile measurement?
- Q 3: How neutron irradiation will affect hydrogen transport in graphite?

o Modeling:

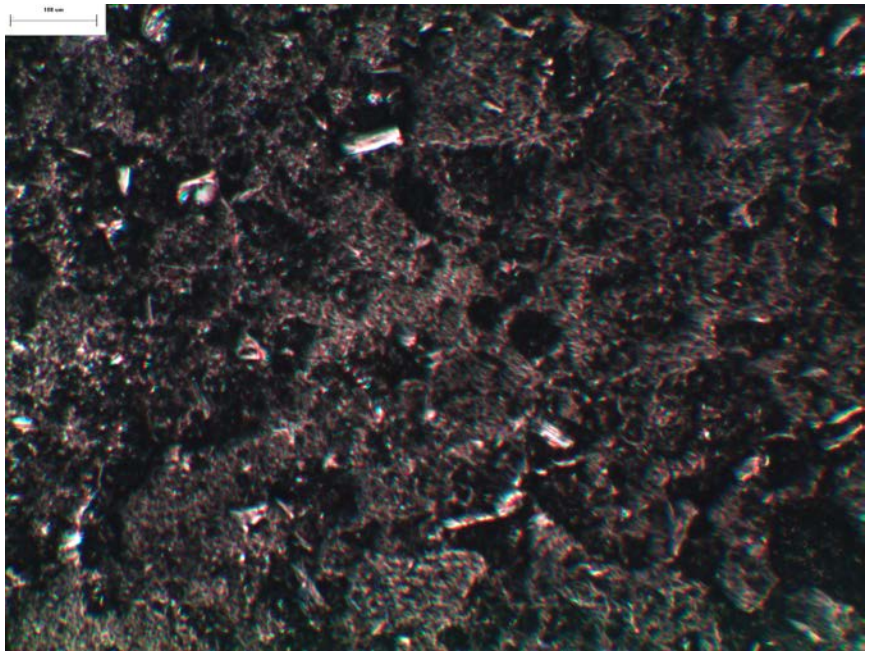
- Q1: Appropriate software for pebble, core, system level simulation?

SEM Image of A3

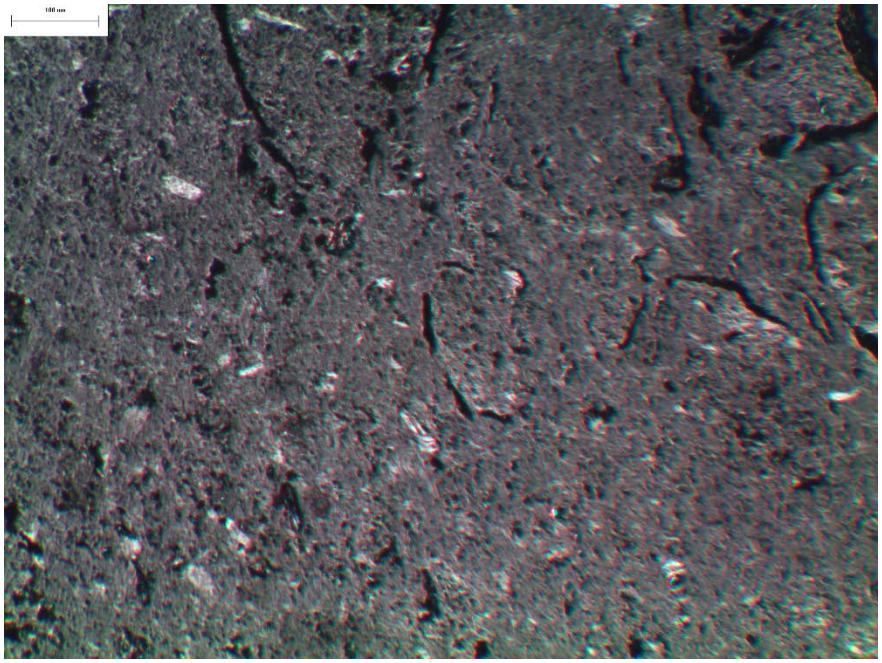




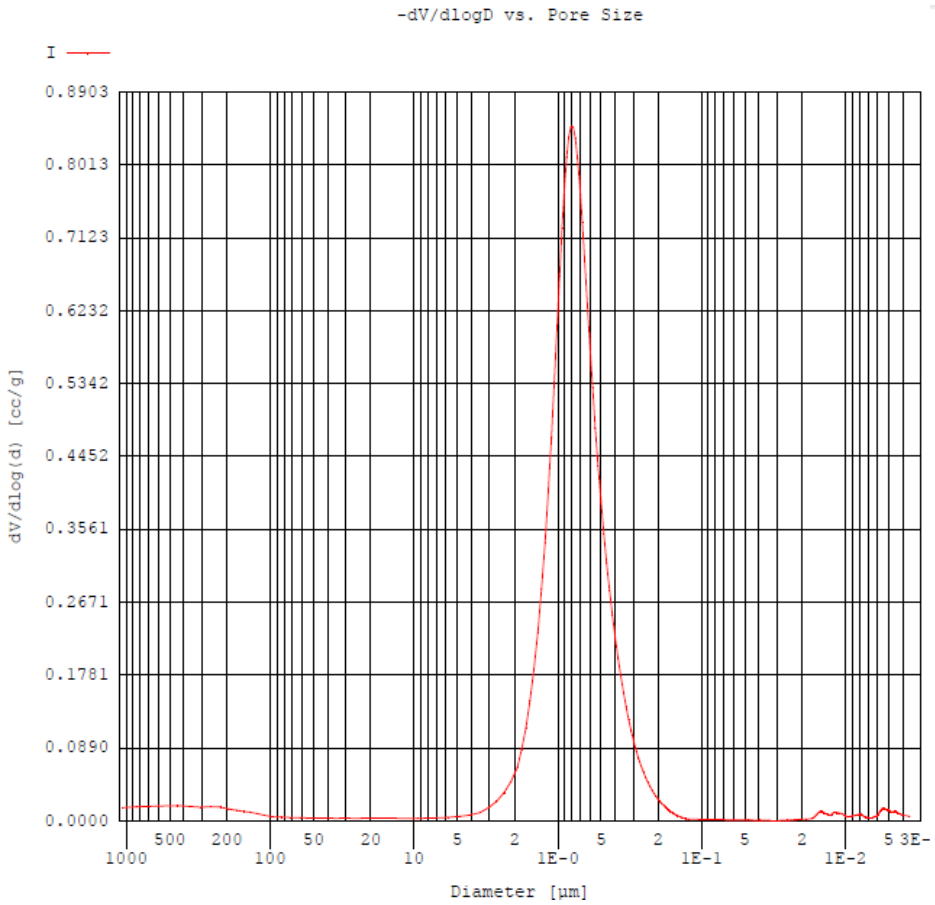
Optical Microscopy Visual Image



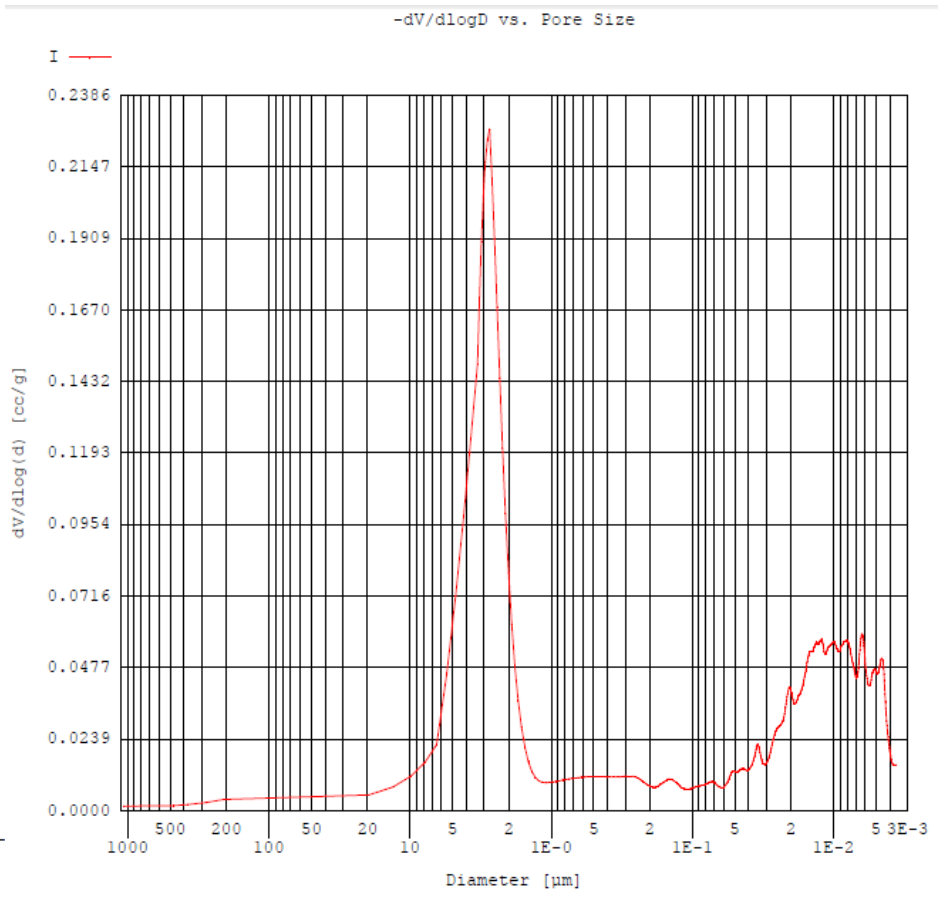
A3 Matrix Graphite



IG-110 Nuclear Graphite

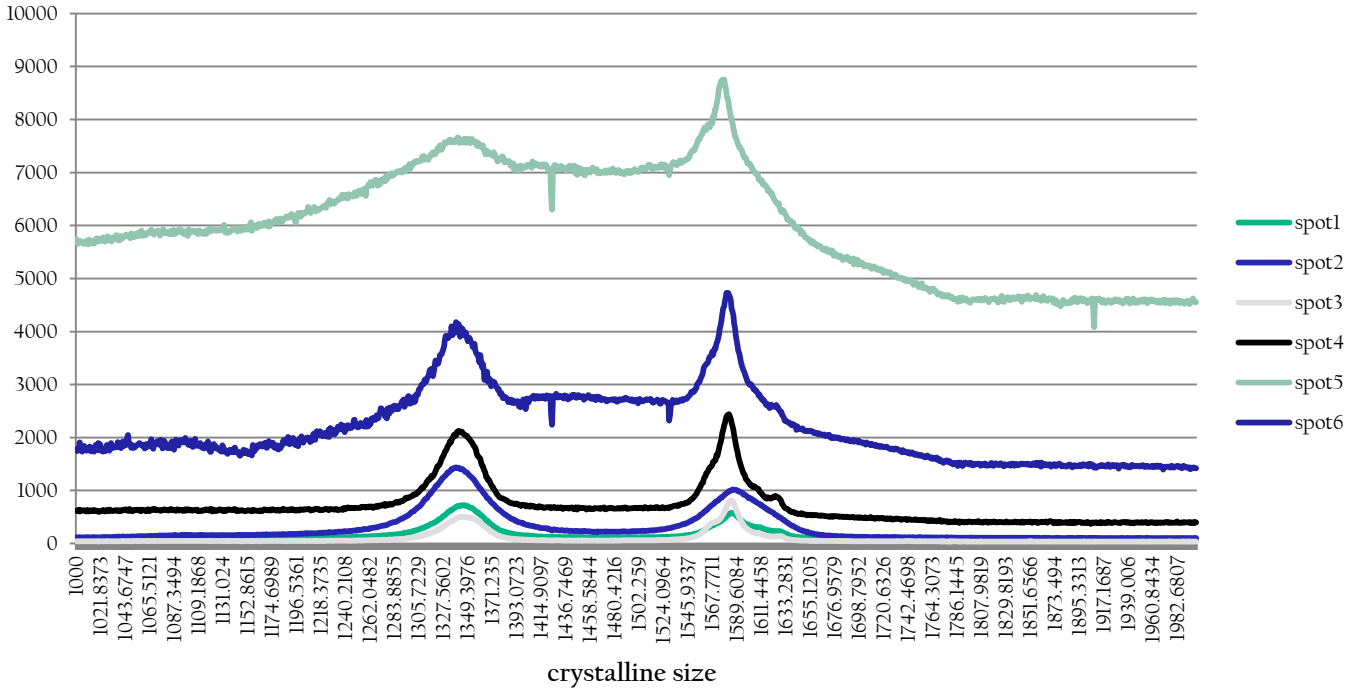


Pore Size Distribution of A3

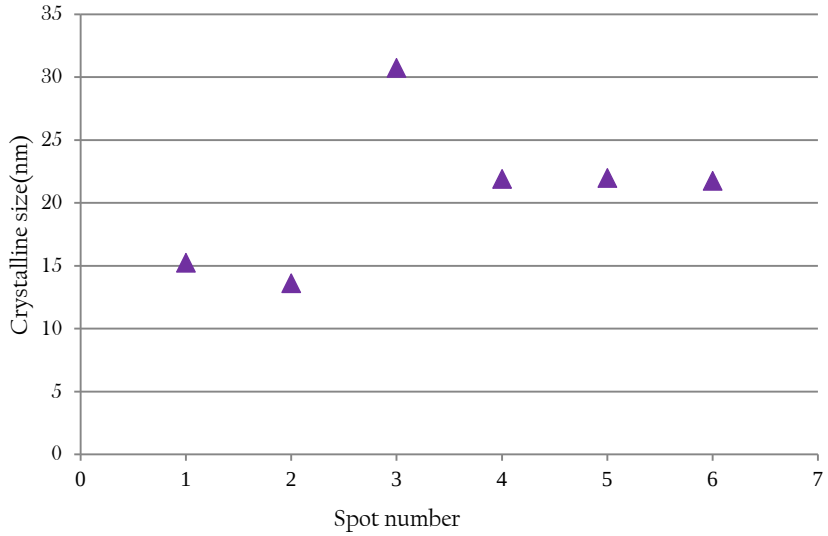


Pore Size Distribution of IG-110

Raman Shifts



crystalline size



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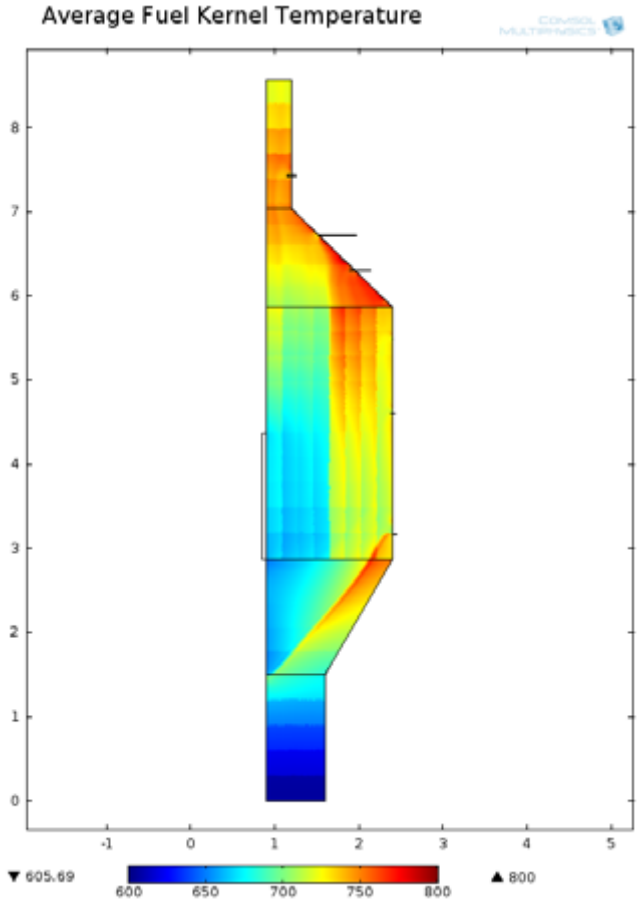
Research Topic 4: Hydrogen-Graphite Simulation on different Scale

- COMSOL is used for hydrogen transport simulation on **pebble** scale and also can be used for **core** scale, as shown in the Fig.1



Q 1: Other modeling software for pebble, core, system scale?