2022 Ablation Workshop

COMPARISON OF ONE-DIMENSIONAL MATERIAL RESPONSE MODELS

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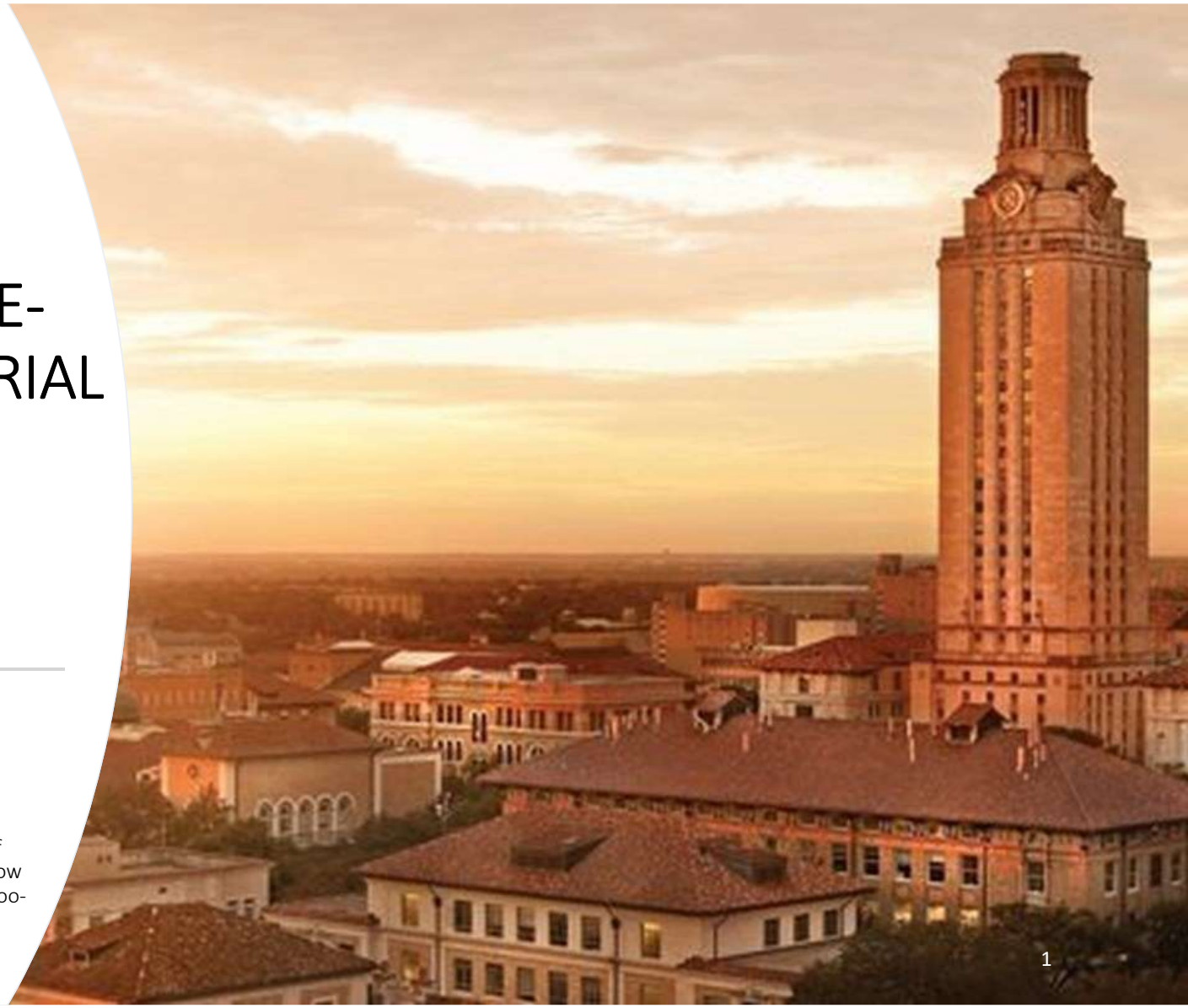


AGENDA


Project Objective
Experimental Approach
1dFIAT Modeling and Machine Learning
ITRAC Modeling
Results
Future Work

PROJECT OBJECTIVE

The purpose of this study is to compare two commonly used one-dimensional material response models against experimental results for surface temperature, in-depth temperatures, and recession.

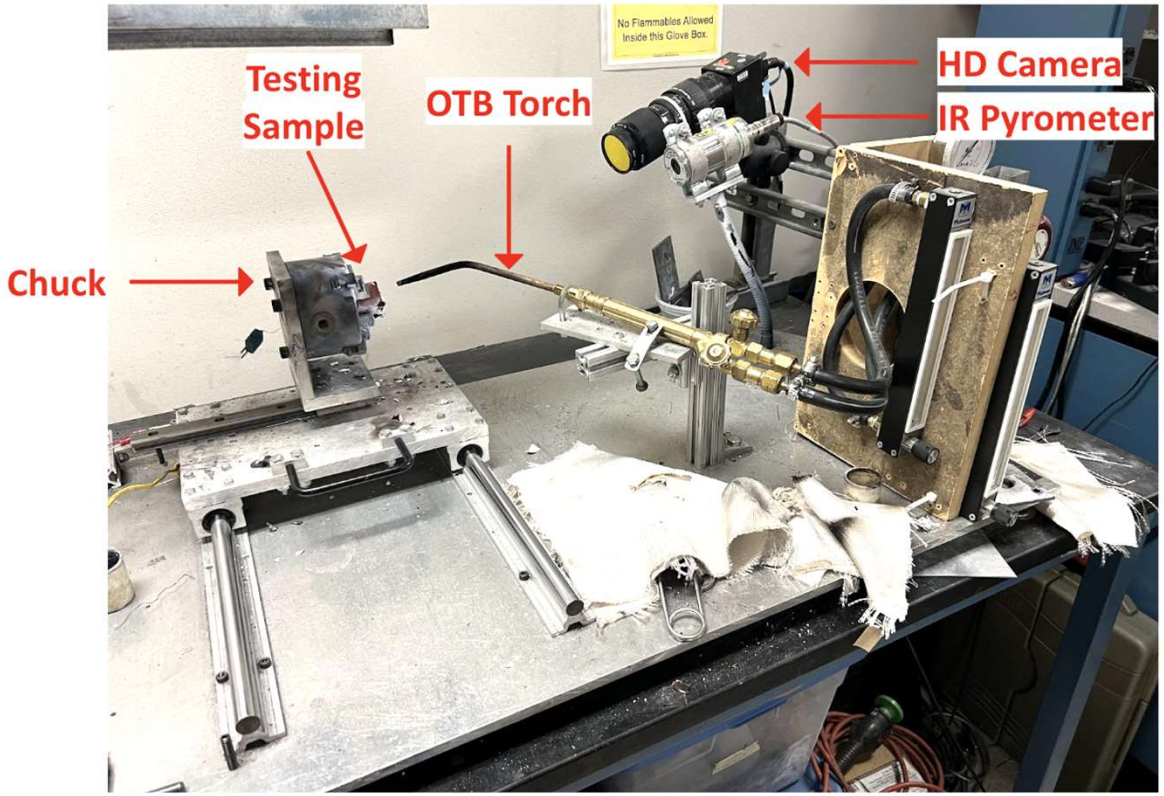
Insulation Thermal Response and Ablation Code (ITRAC)

1d Fully Implicit Ablation and Thermal Response Program (1dFIAT)

Oxy-Acetylene Test Bed (OTB)

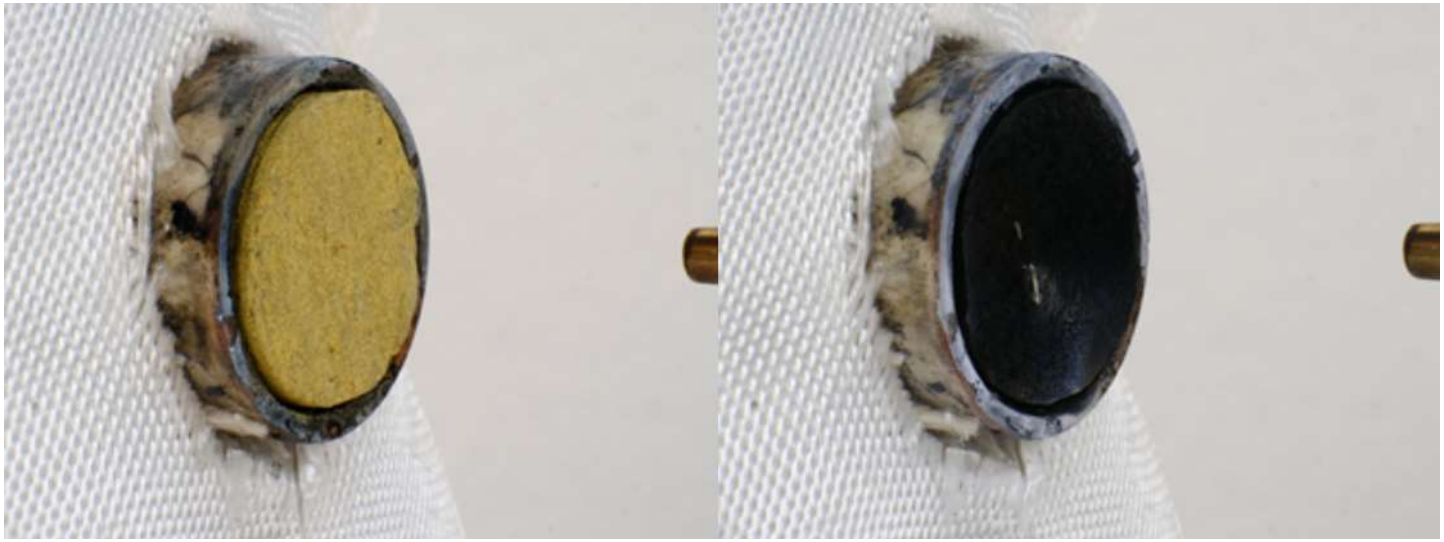
EXPERIMENTAL APPROACH

EXPERIMENTAL APROACH - OTB



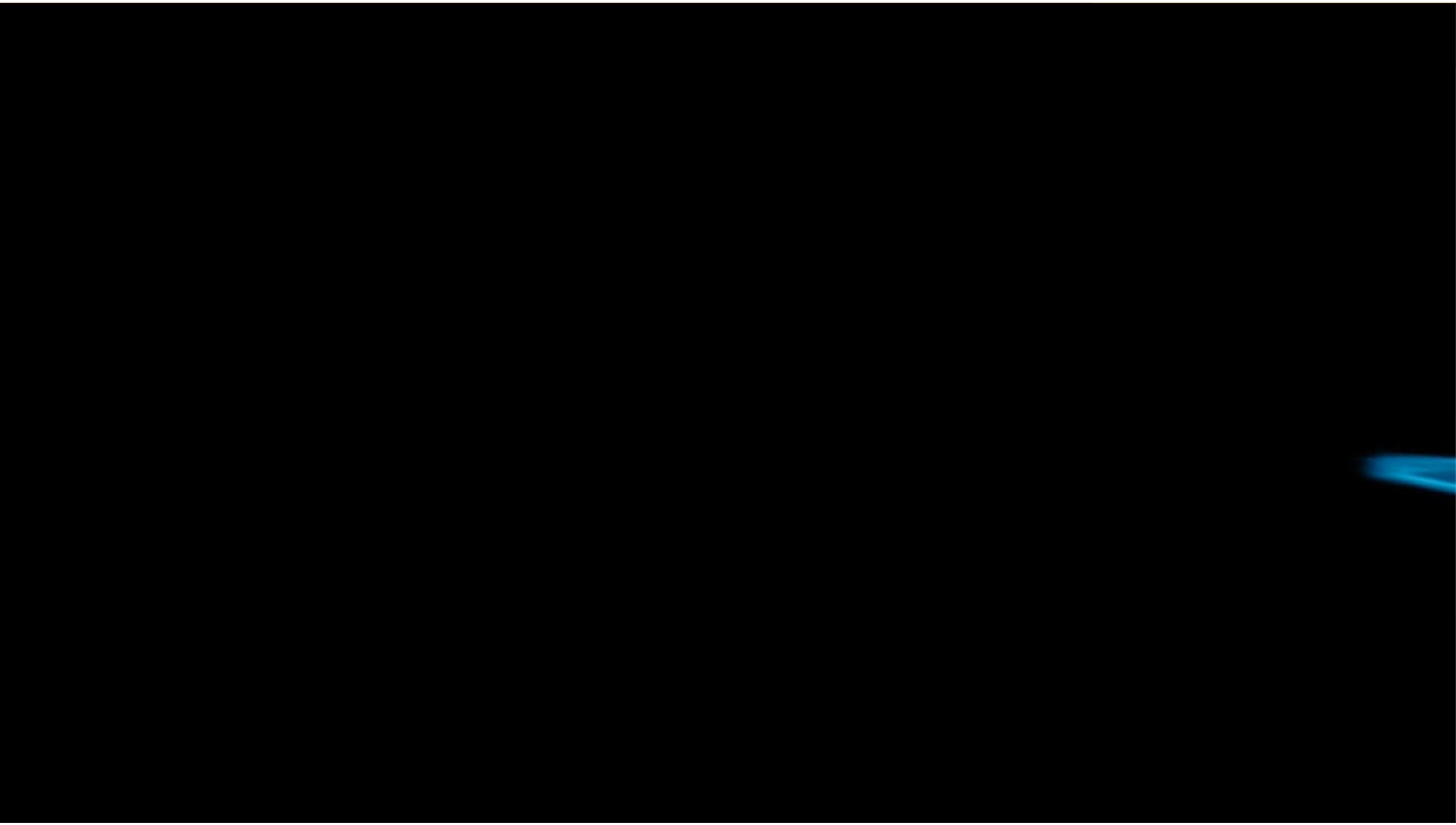
EXPERIMENTAL APROACH - PICA

Sample Number	Heat Flux (W/cm^2)
1	250
2	250
3	250
4	500
5	500
6	500
7	750
8	750
9	750

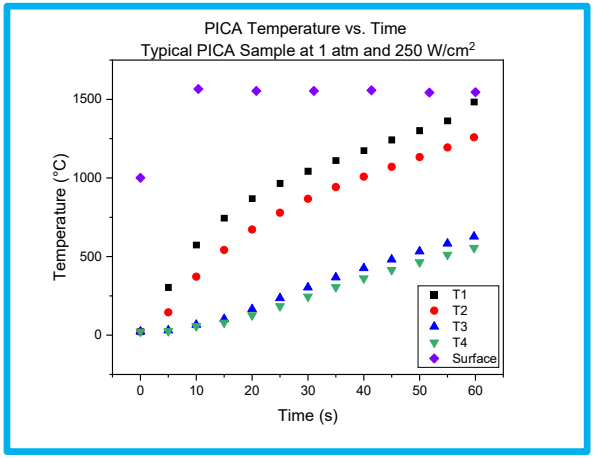


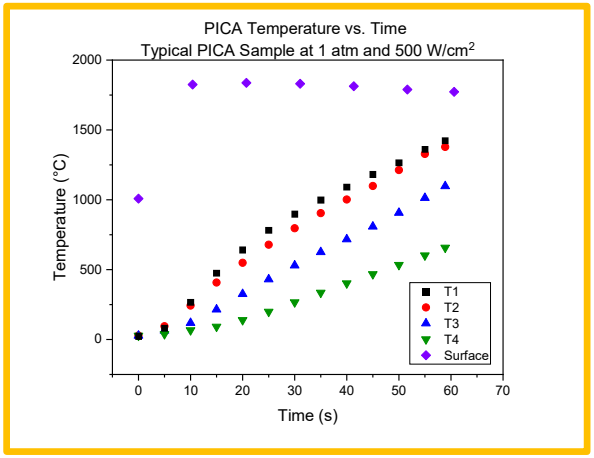
PICA pre-test sample

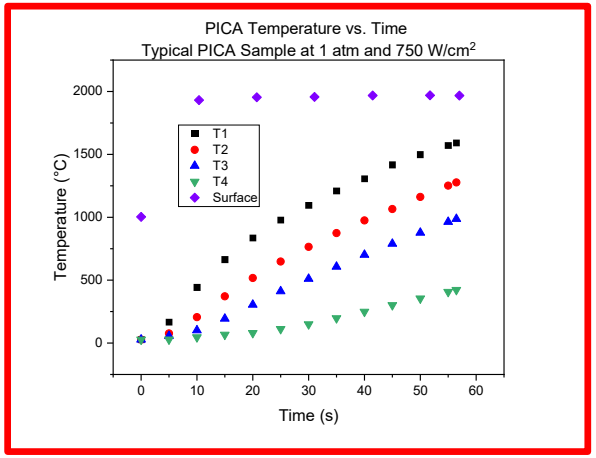
PICA post-test sample

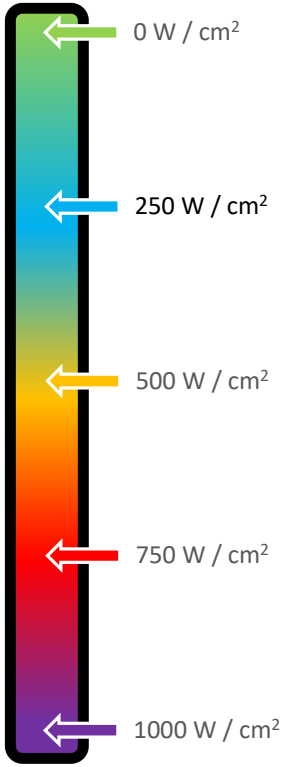


EXPERIMENTAL RESULTS - TEMPERATURES









MODELING THE OTB WITH 1dFIAT

MACHINE LEARNING 1dFIAT

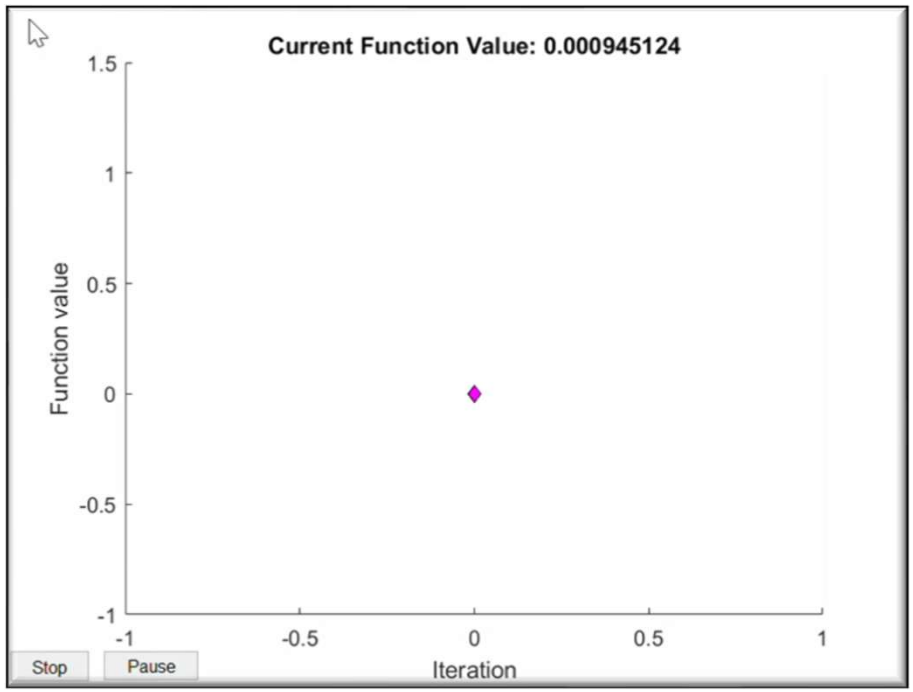
Minimize Error Between:

[Experimental Surface Temperature Experimental Recession]

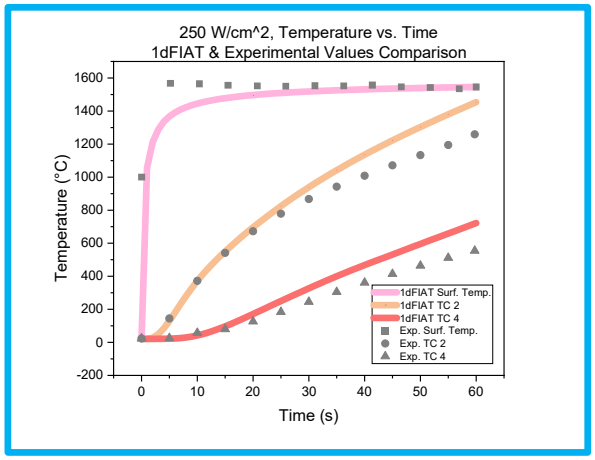
[1dFIAT Surface Temperature 1dFIAT Recession]

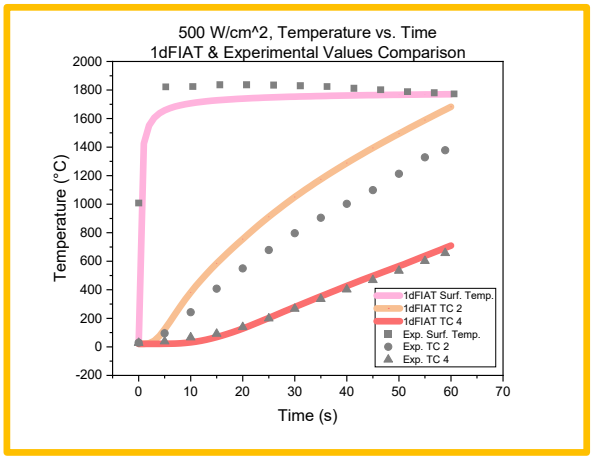
By Varying:

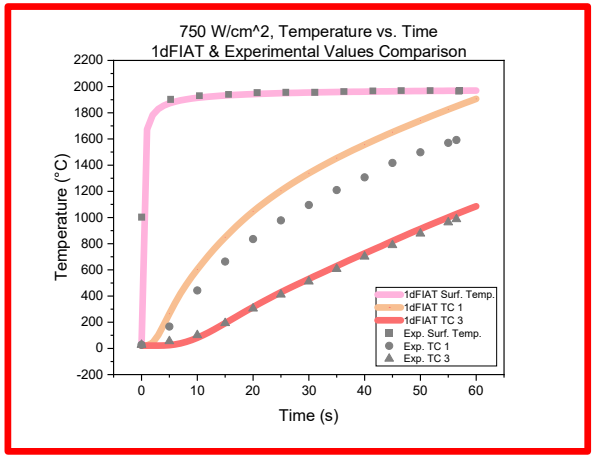
[1dFIAT Recovery Enthalpy 1dFIAT Heat Transfer Coefficient]

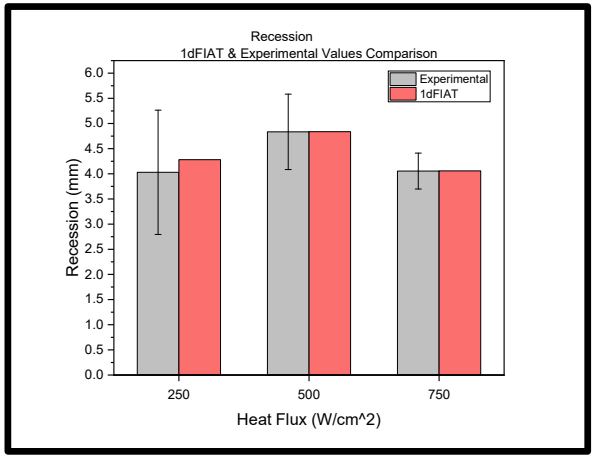


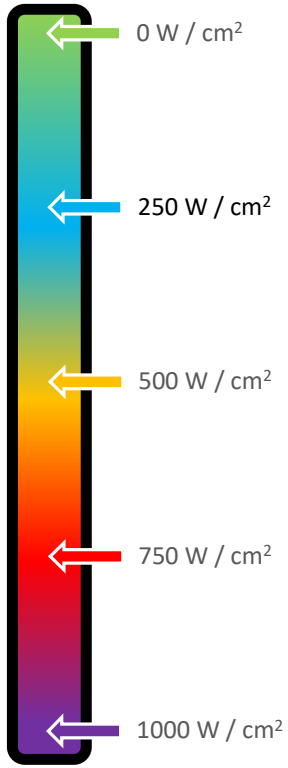
MACHINE LEARNING 1dFIAT





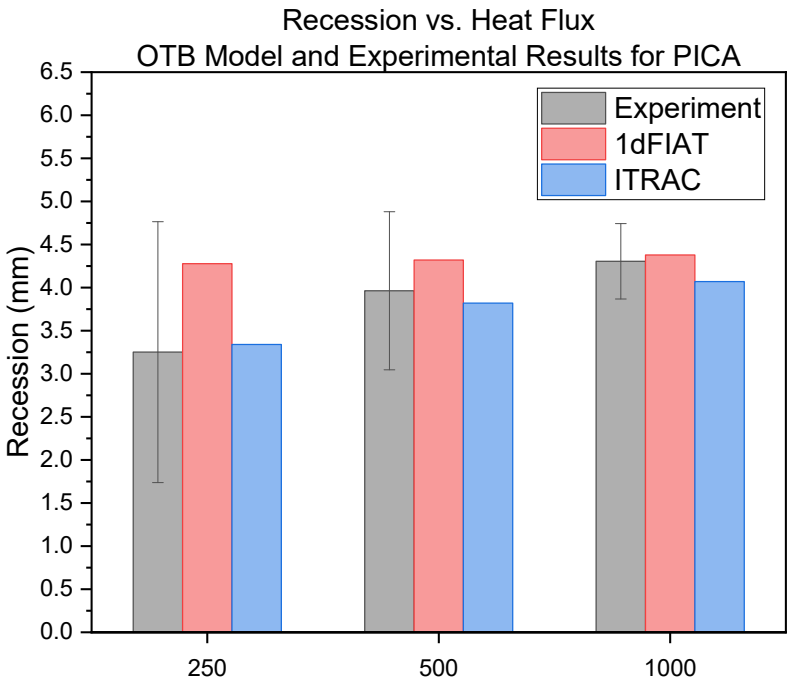


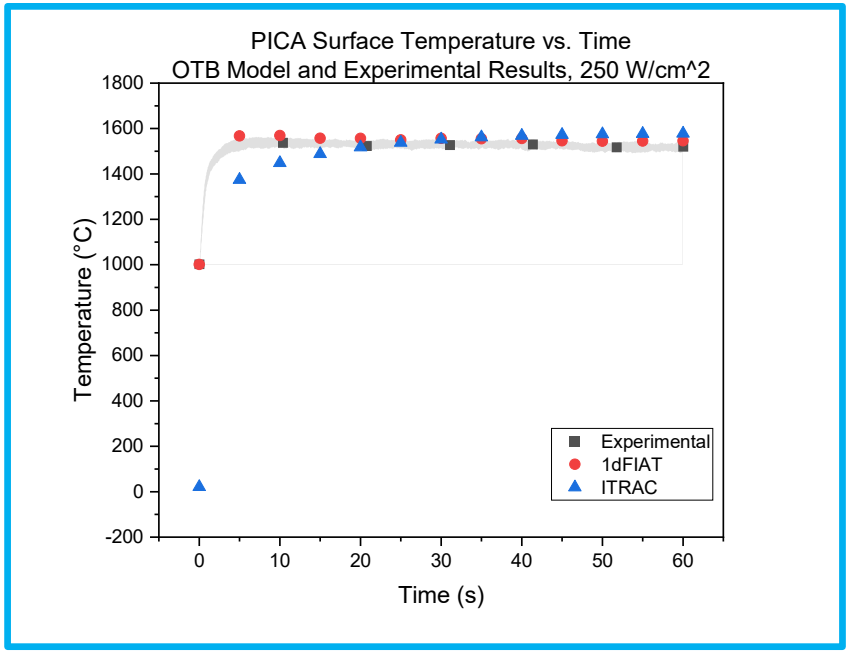


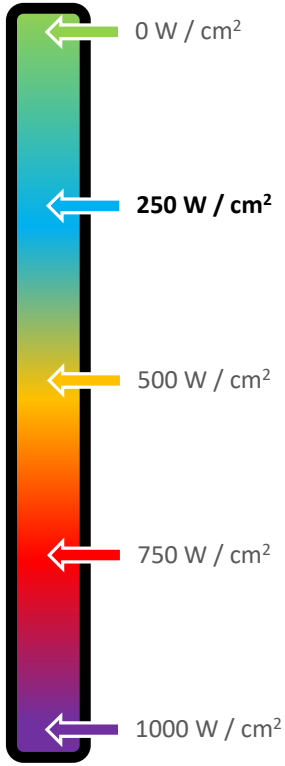


MODELING THE OTB WITH ITRAC

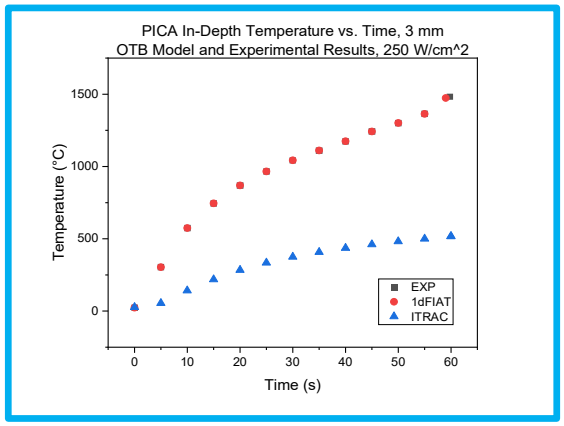
MODEL COMPARISON – SURFACE TEMPERATURE

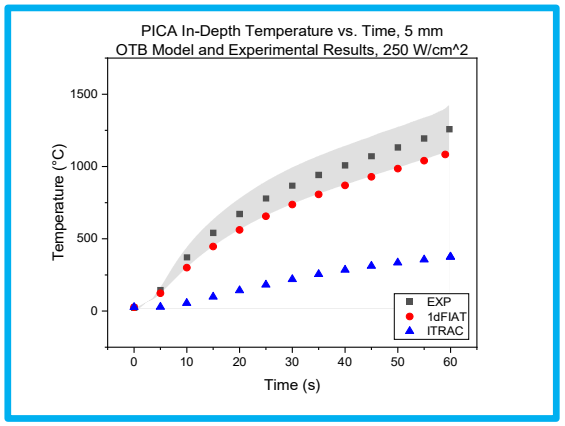


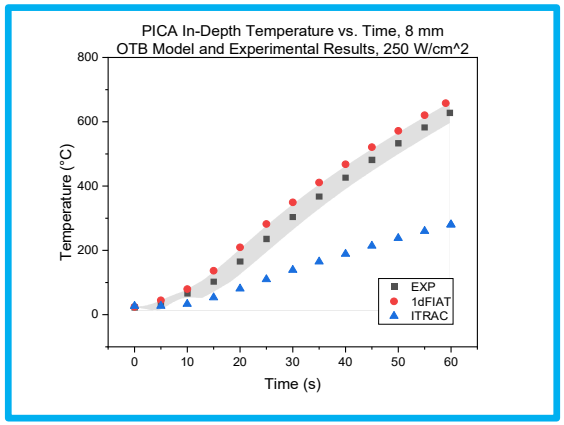


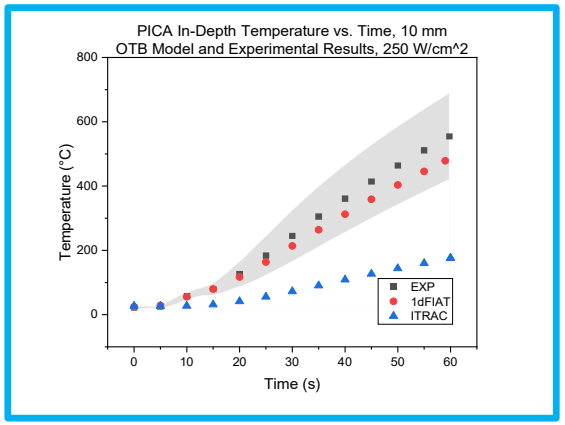


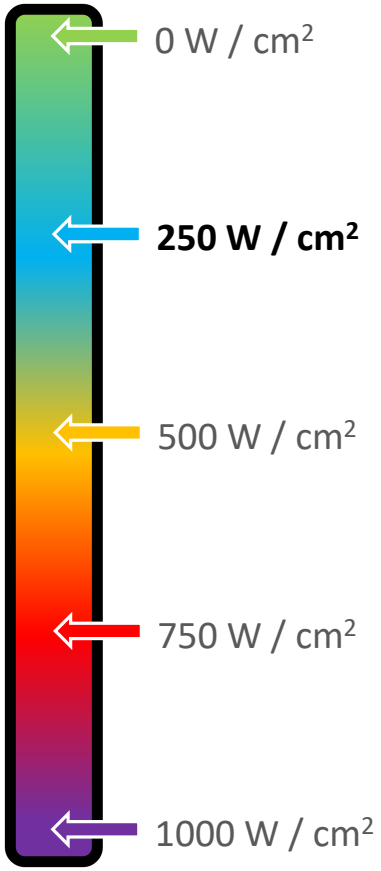
INITIAL MODEL COMPARISON



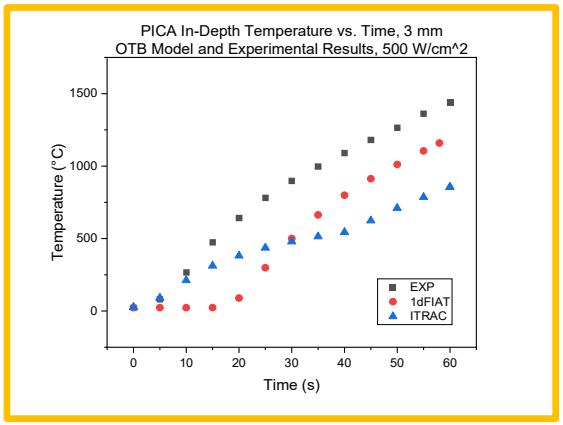


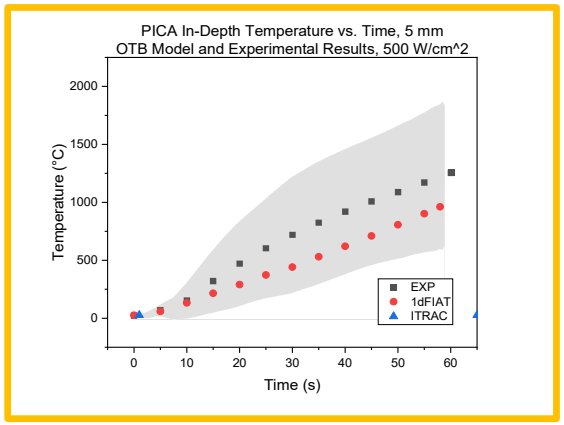


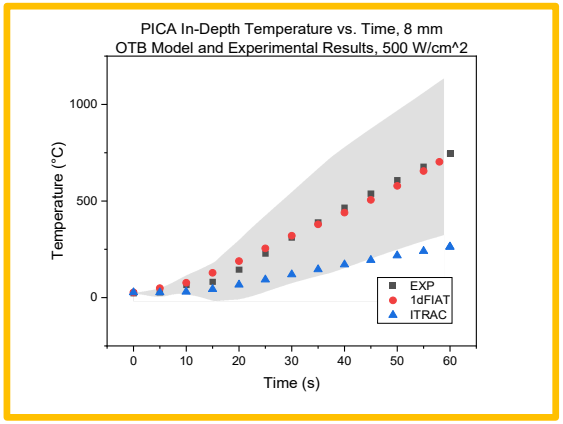


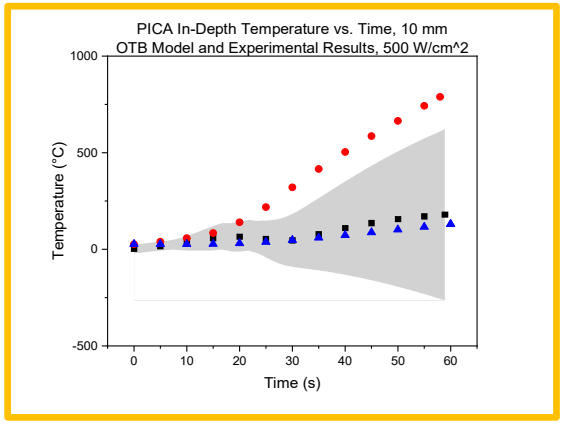


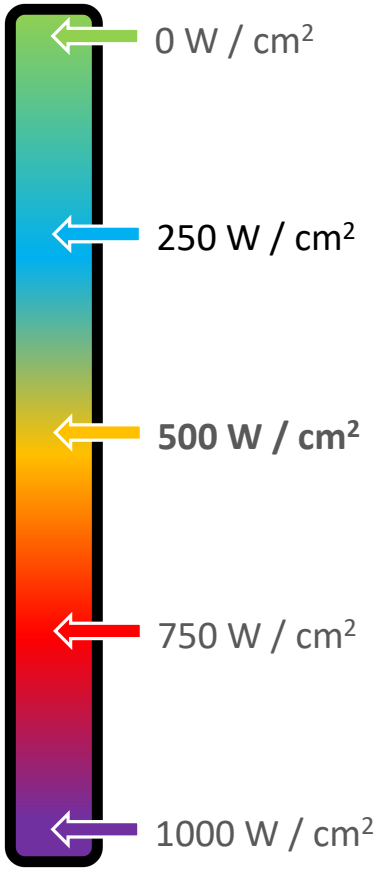
INITIAL MODEL COMPARISON











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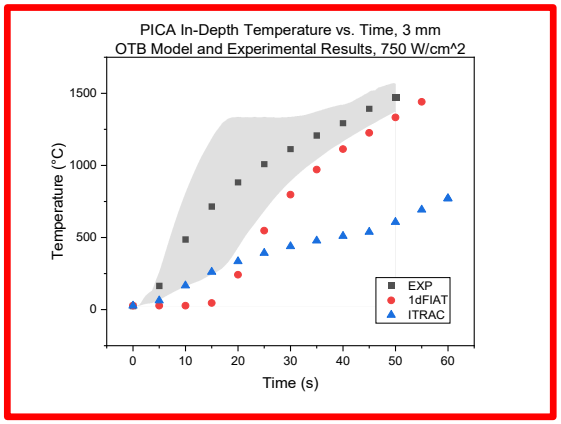
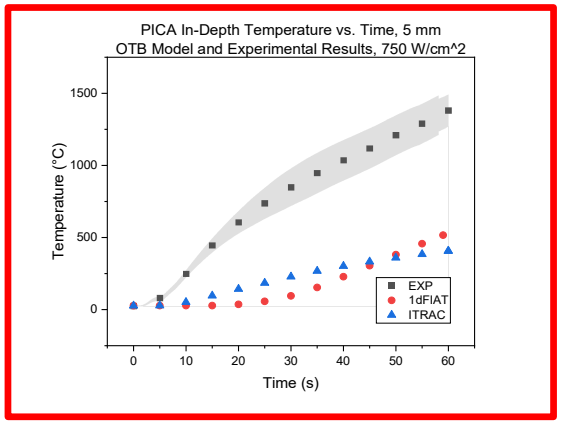
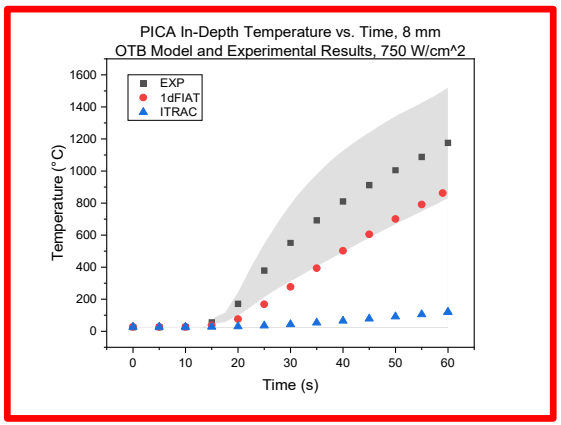
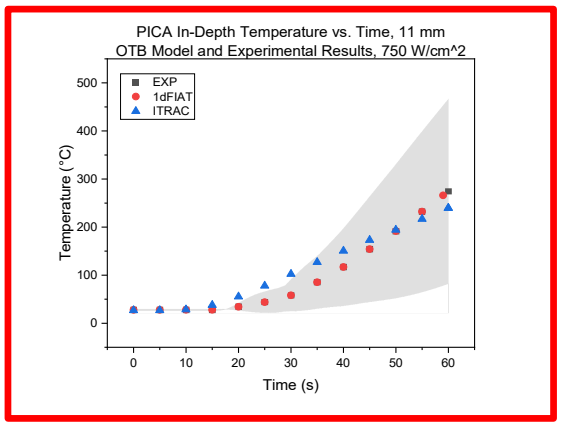
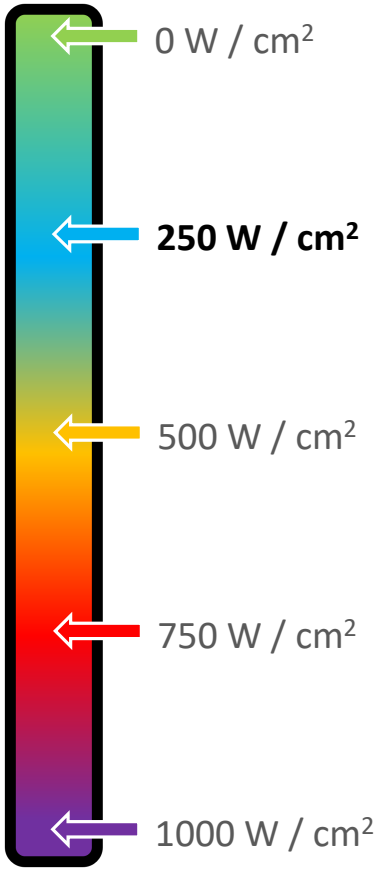


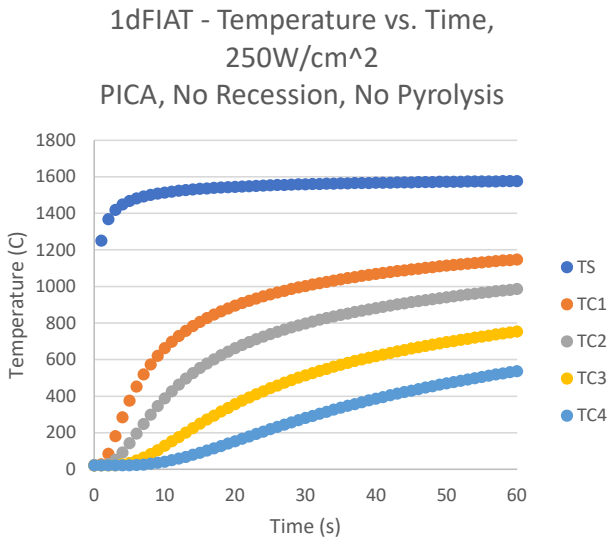


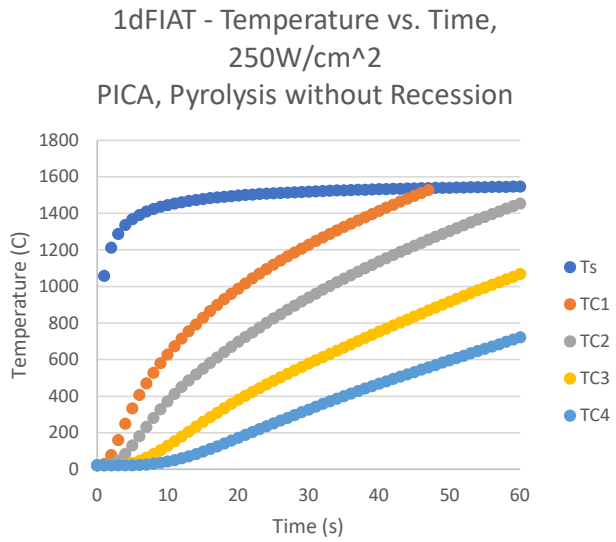


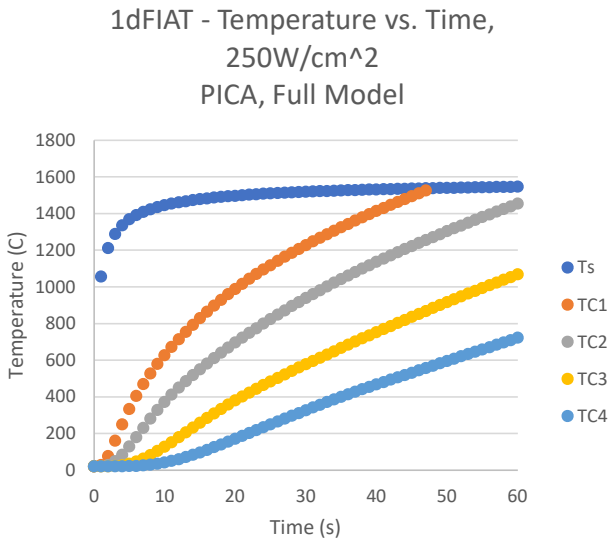




SIMPLIFIED MODEL APPROACH

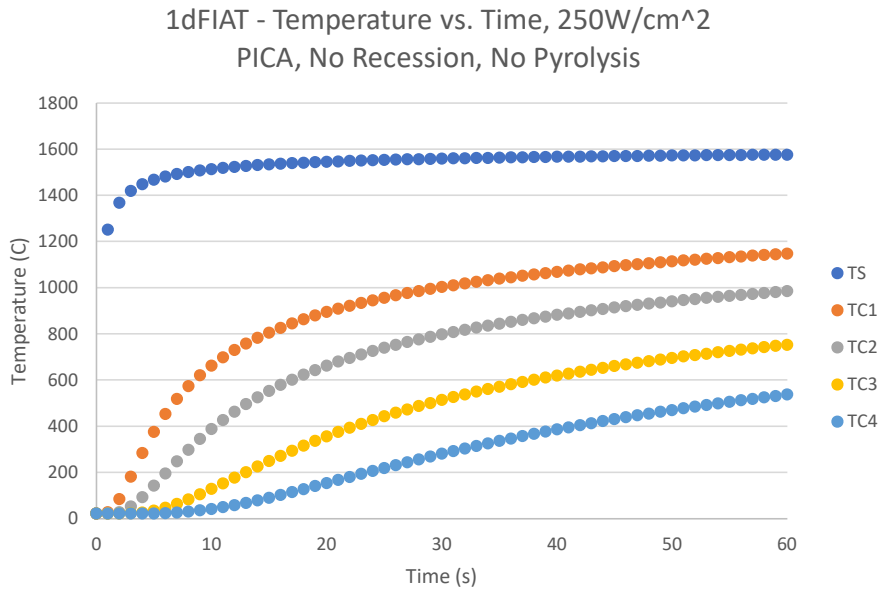


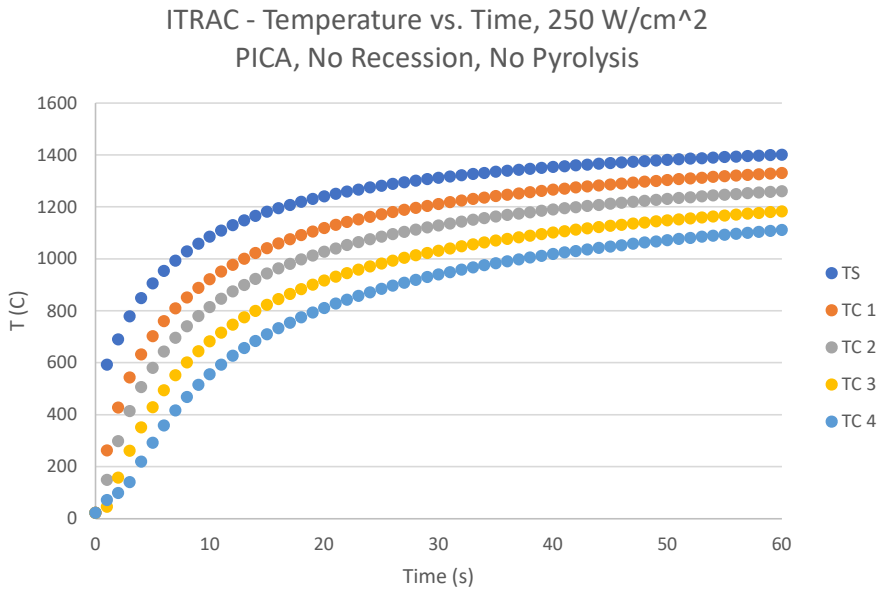




No Pyrolysis, No Surface Recession → No Surface Recession → Full Model

ITRAC THERMAL CONDUCTIVITY





CONCLUSIONS & FUTURE WORK

Future Work

- Continue to work on ITRAC model
- Prove 1dFIAT machine learning model is predictive
- Add other material response models
- Start changing the material studied
  - Carbon Phenolic
  - PICA Flex
  - New materials

Thank You!

- UT AUSTIN
  - Dr. Joseph Koo
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  - Steven Kim
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- KAI
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  - Dr. Louis Pilato
  - Ben Rech
- NASA AMES
  - Dr. Joshua Monk
- Northrop Grumman
  - Dr. Mark Ewing

Questions? Suggestions?