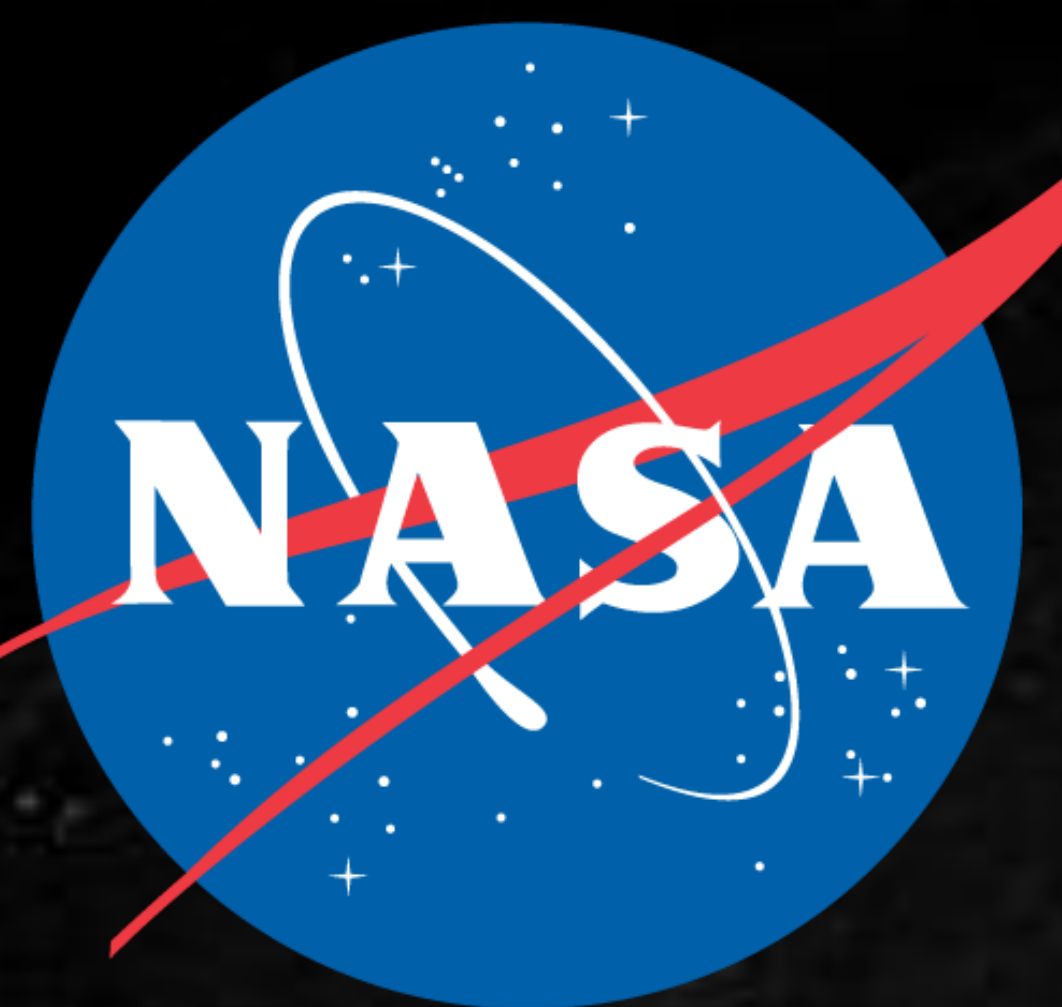




Strong Thermoset Regolith UV-Curable Composite Technology (STRUCT) Overview

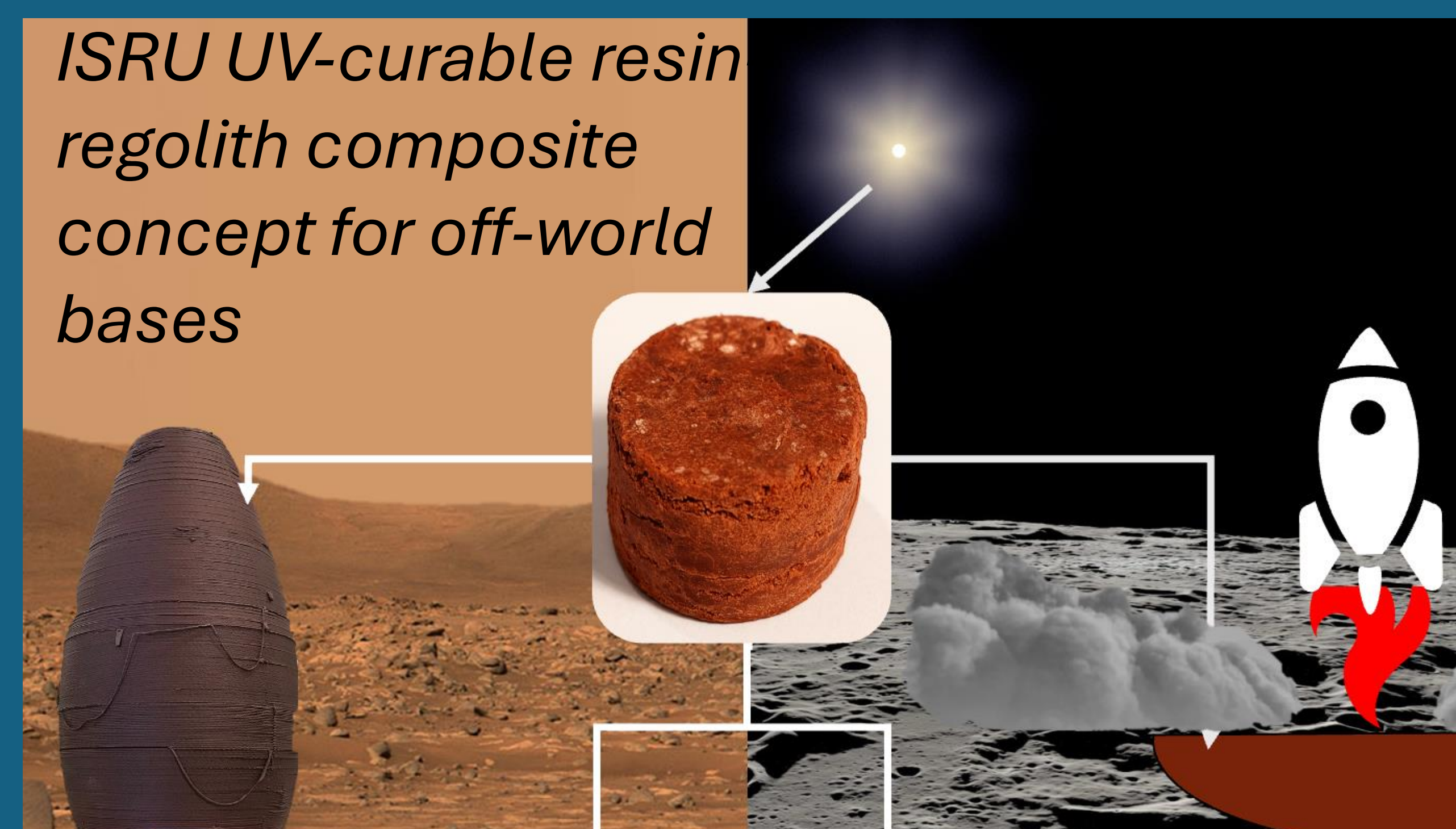
Tane Boghozian¹, Sergio Fraile Izquierdo¹, Vuong Do¹, Daniel J. Rasky² and Andrew P. Santos³

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Motivation

- Need for energy-efficient manufacturing of materials on the Moon.
- Advanced thermo-structural materials are needed for lunar T cycle, power and landing.
- Earth-based resin-regolith composite are promising for heat shields and landing pads.



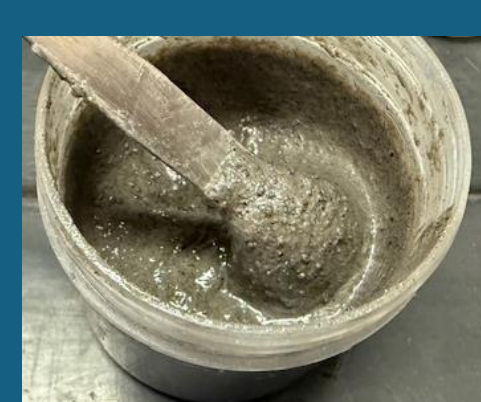
Next Steps

- MISSE-23 space environment testing
- Additive manufacturing of regolith
- Computational composite optimization
- Looking for partners testing under Lunar conditions

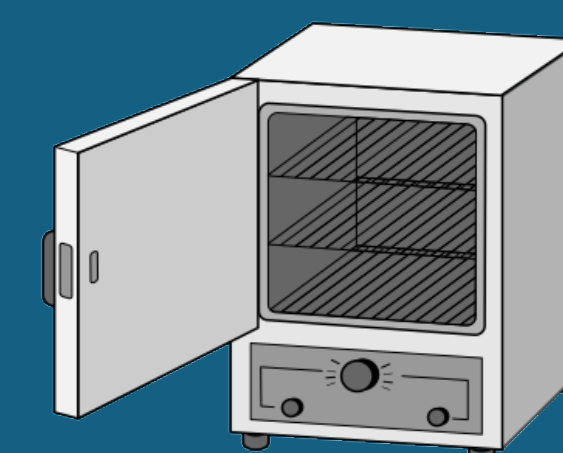
Development

UV/thermal-cure resin-regolith system capable of using regolith-extracted Si and C

LHS-2E



UV Cure



MIX
Monomers
Photoinitiators
Regolith
Simulants
Basalt fibers

Failed Experiments

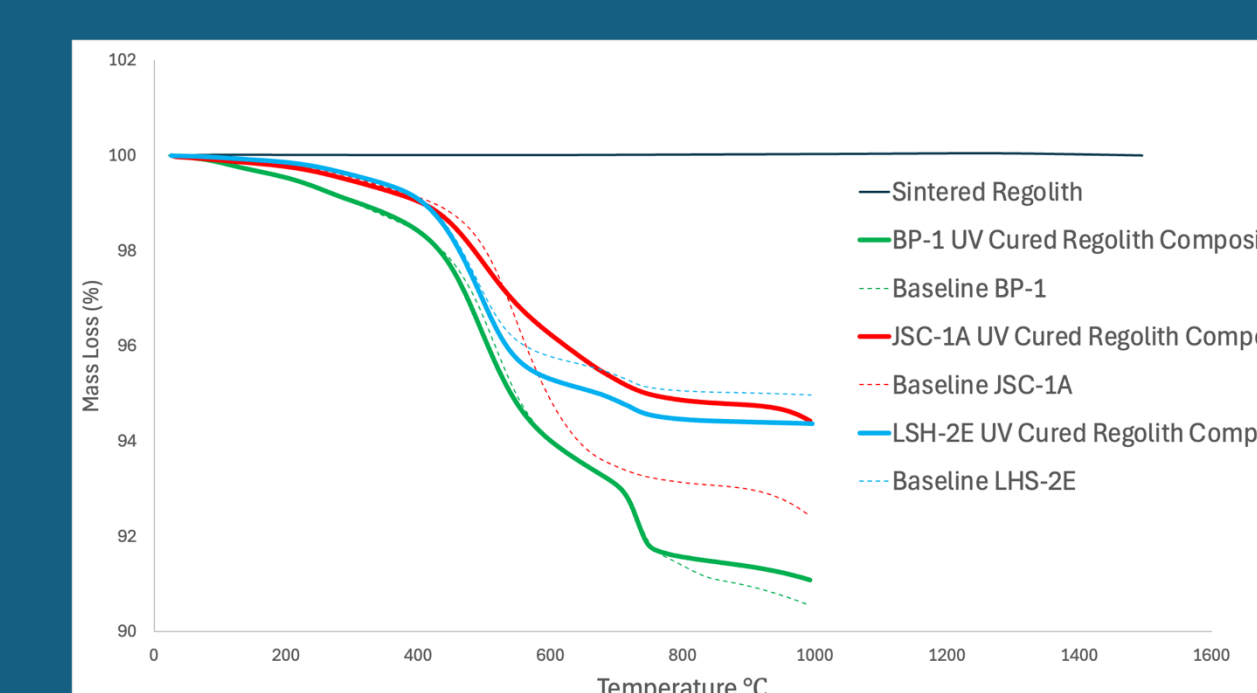


Characterization

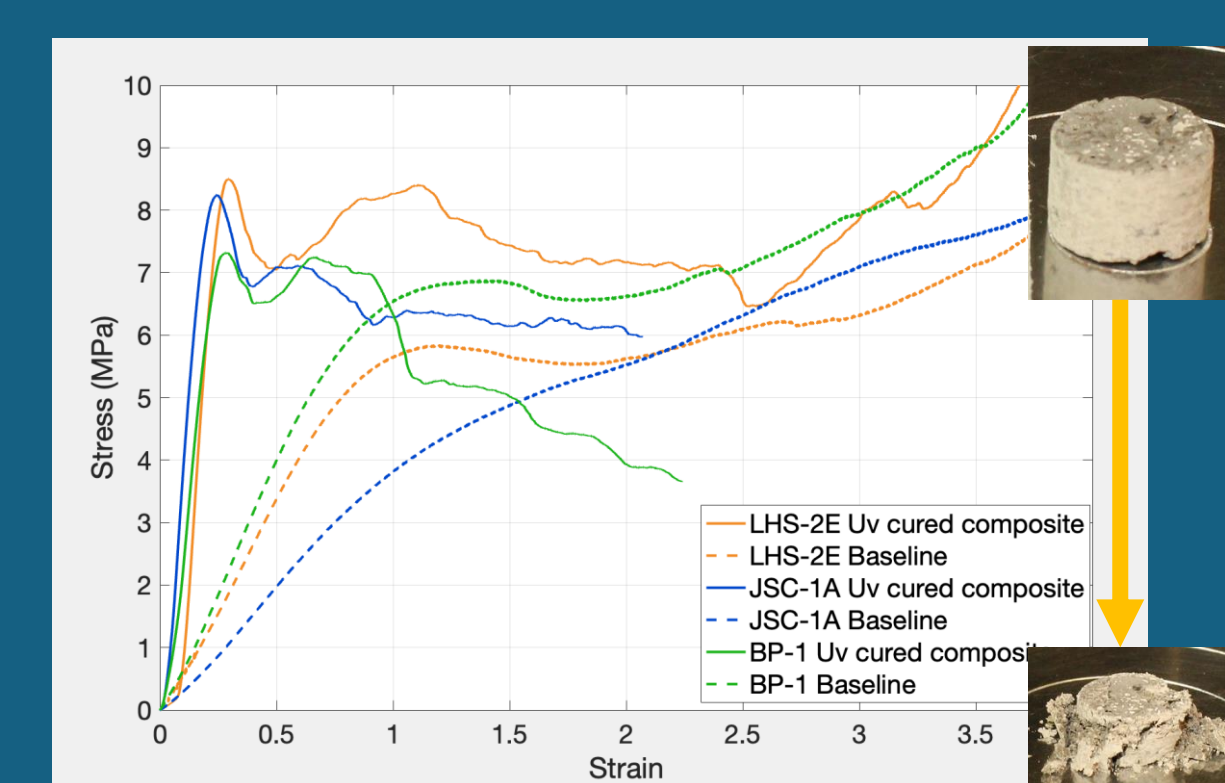
New dual-cure resin composite has improved thermal and mechanical properties for landing pad systems and other infrastructure

Resin/simulant composite material properties.

sample	char g/g %	char _{resin} g/g %	T_g °C	ΔH_{rxn} mW/mg	σ_{peak} MPa	$\epsilon_{failure}$ m/m %
UV/BP1	91.5	15	120	-0.05	7.32	2.2
T/BP1	91	10	125	-0.1	19.0	4.6
UV/JSC1	94.5	45	140	-0.35	8.25	2.1
T/JSC1	93	30	145	-0.18	18.0	5.1
UV/LHS2E	95	50	135	-0.12	10.1	3.7
T/LHS2E	95	50	140	-0.2	11.0	4.5



High char yield due to low resin mass ratio.



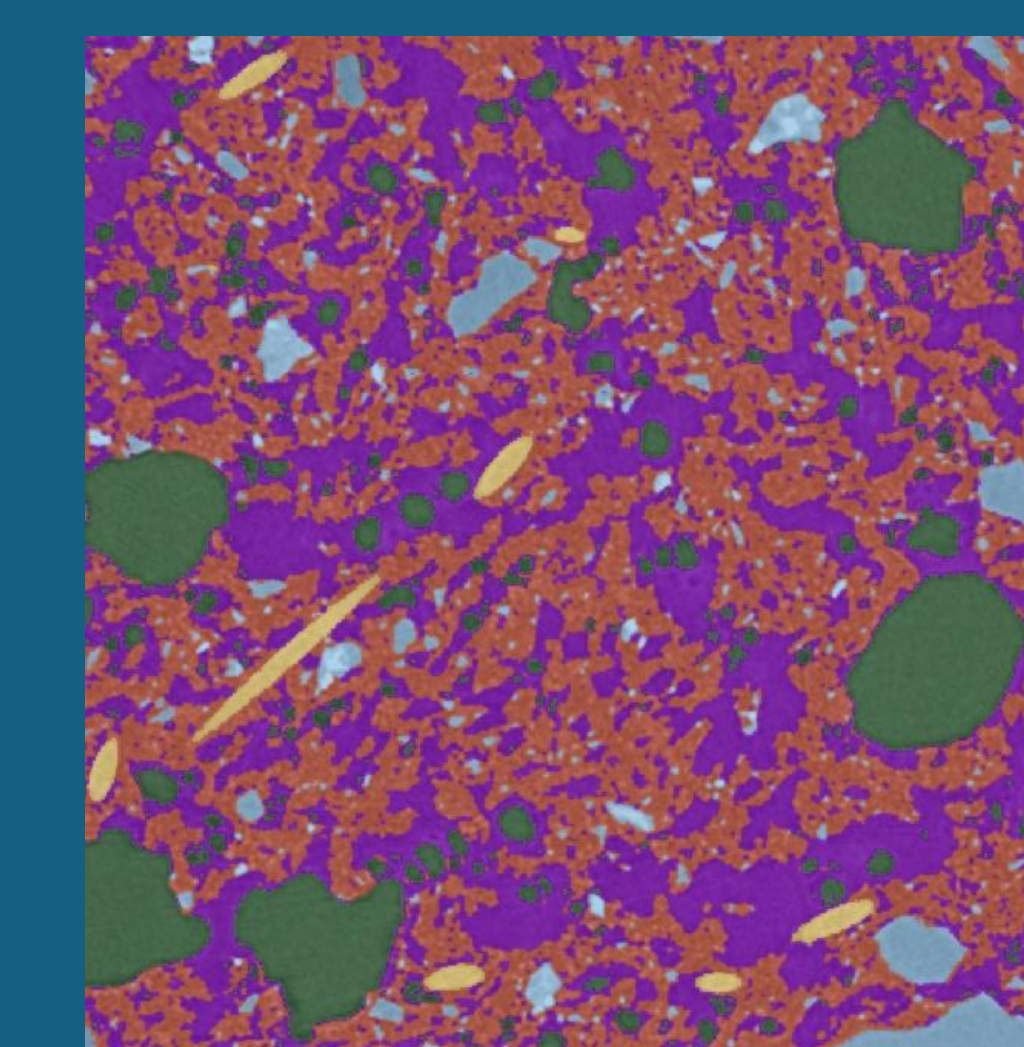
Increased compressive stiffness of new resin formulation.



Torch test.

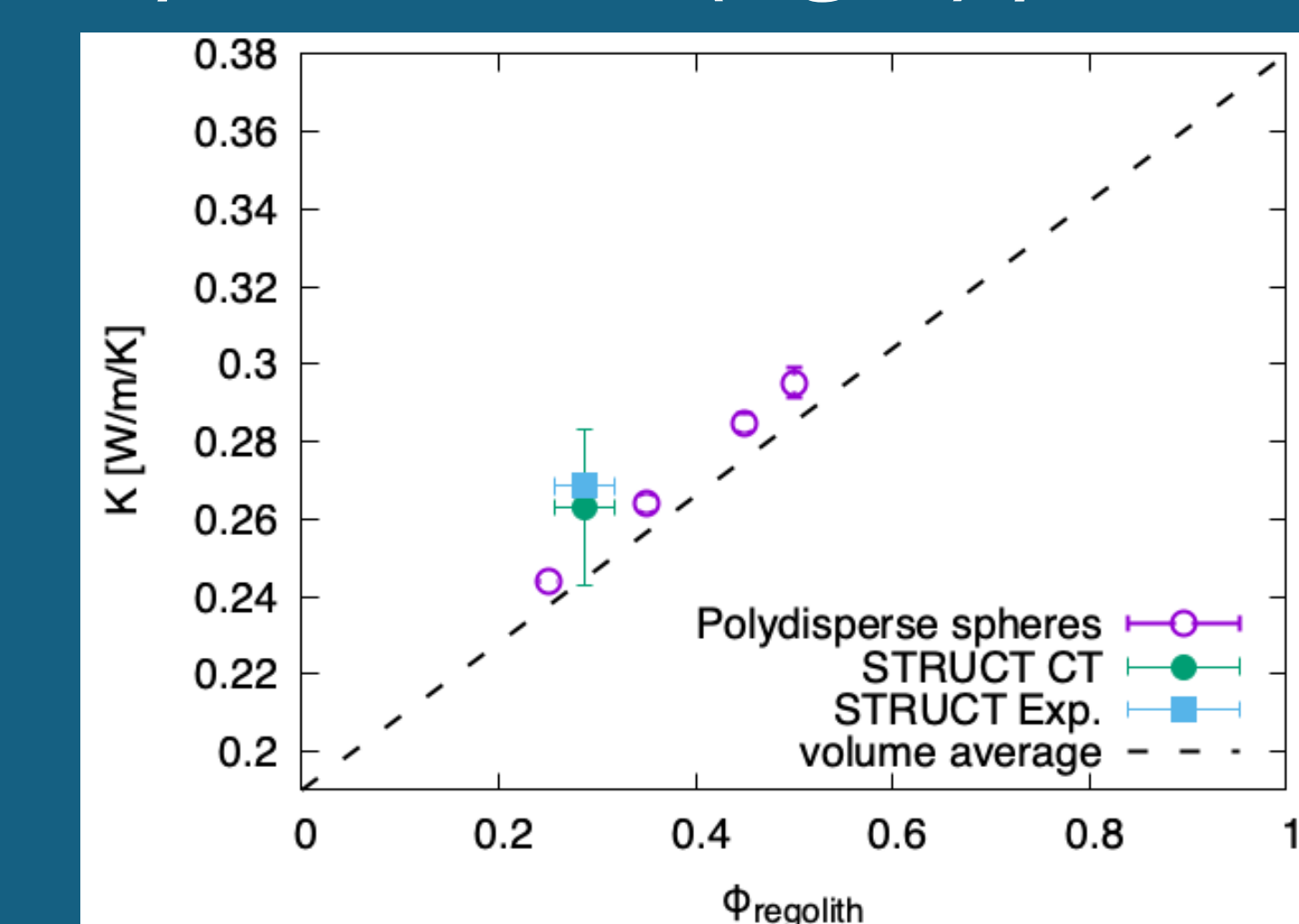
Computational Analysis

Analysis quantified structure and predicted thermal property



Label	Phase	Vol %
Green	Air	10
Purple	silicone	38
Red	UV resin + fines	44
Blue	JSC-1A regolith	7
Yellow	Basalt fibers	1.

(left) segmented resin-regolith composite and (right) phases.



Thermal conductivity K vs regolith volume fraction.