

# Energy Efficient, Incrementally Scalable. Continuous Basalt Fiber Filament-forming Extrusion Bushing

**PI: Erik Kiilunen, Neuvokas Corporation**

**Team Members: Loukus Tech, Laurium Labs, Michigan Technological University, REL Inc.,**

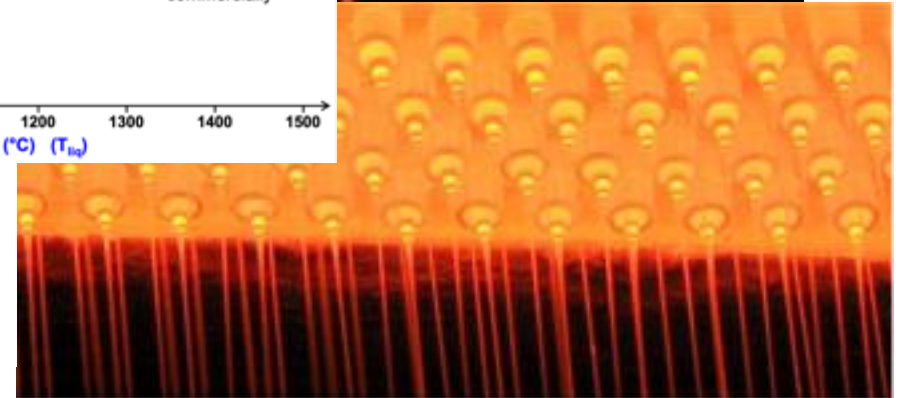
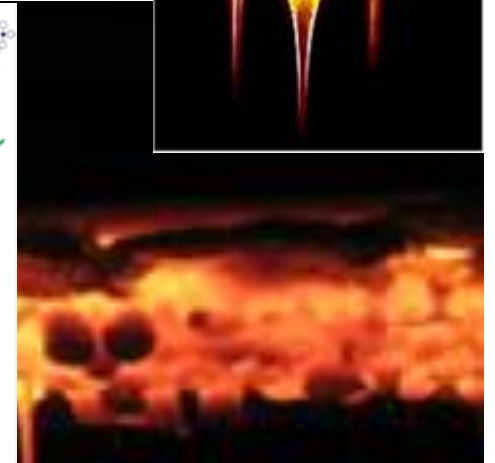
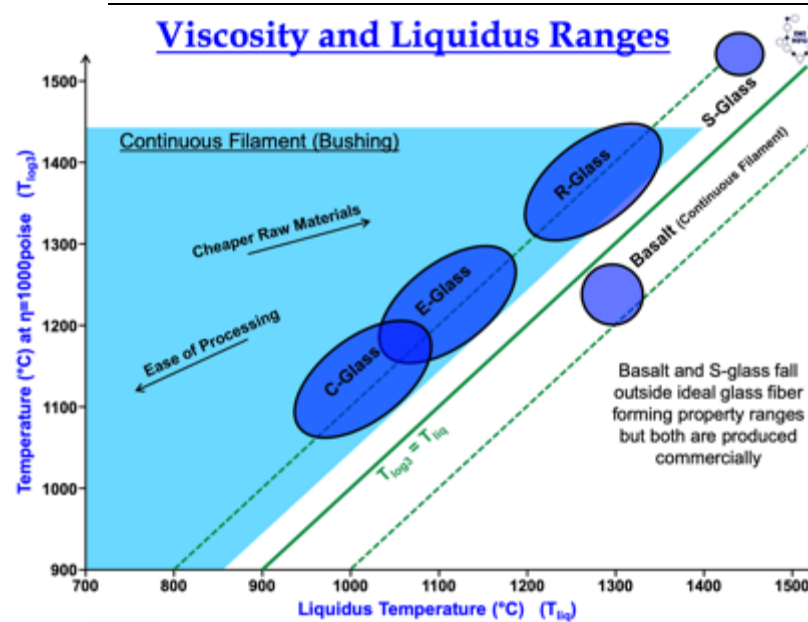
## Project Vision

Solve throughput to reduce the cost of basalt fiber below the cost of glass fiber.

Total Project Cost:	\$2.0M
Length	24 mo.

# The Concept

- ▶ Bushings are traditionally produced from Pt/Rh alloys
- ▶ Neuvokas plans to produce a composite bushing that will.
  - Reduce or eliminate alloy loss
  - Provide increased stiffness
  - Eliminate creep
  - Improve thermal stability
  - Reduce cost >50%
  - Increase through-put by 12X



Photos and chart from presentation by Elam Leed, Johns Manville, US National Science Foundation (DMR-0844014)

# The Team

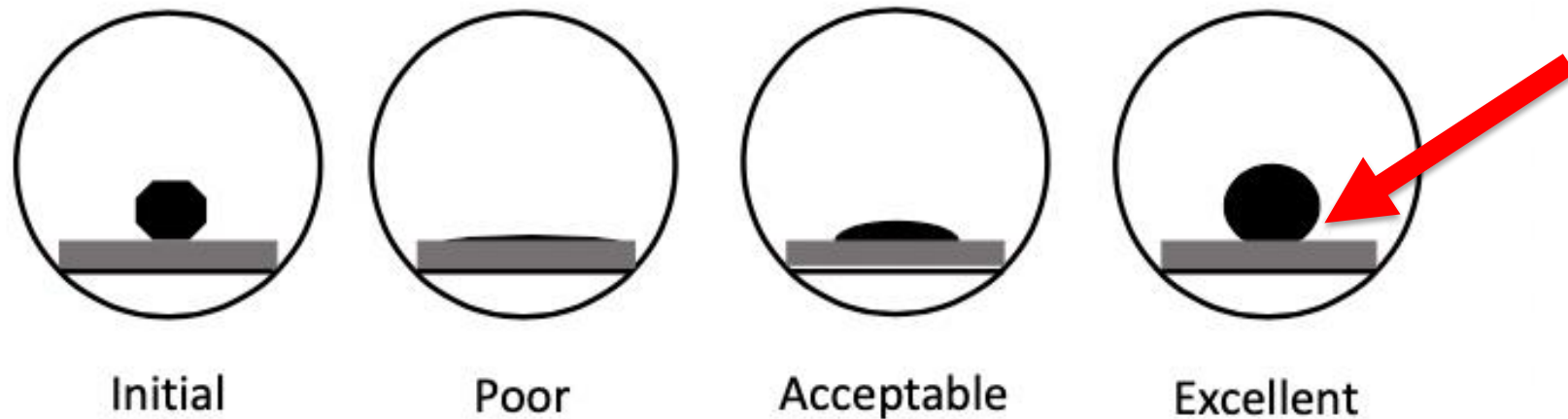
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- ▶ Neuvokas is a 6 year old start-up that successfully developed a process to produce FRP rebar at 250 ft/min and created a market to sell this production
- ▶ We are Entrepreneurs, Engineers, Scientists and Technicians
- ▶ Our subs are being developed further but include Michigan Technological University, REL Inc., planning to add Loukus Technologies and Laurium Labs



# Project Objectives

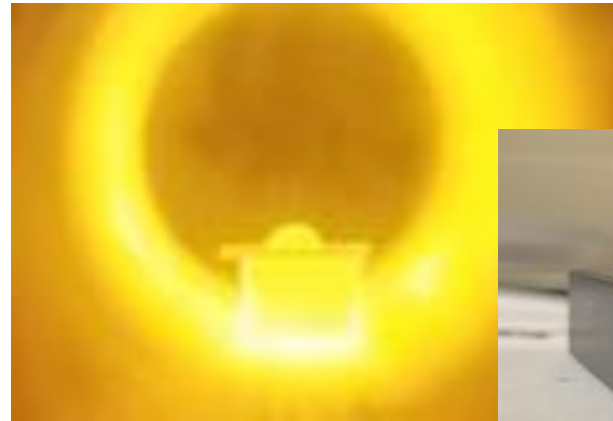
- ▶ Reduce the cost of continuous basalt fiber below the cost of glass fiber to enable mass market adoption
- ▶ Focused research on the interface between the basalt melt and the bushing



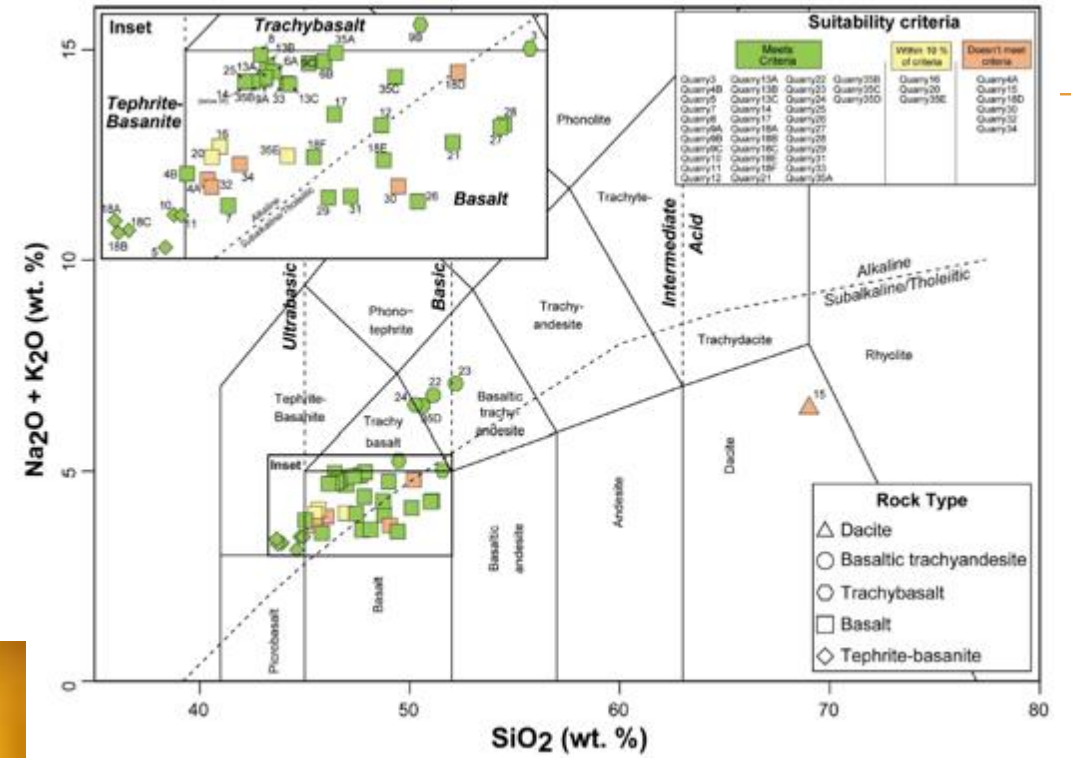
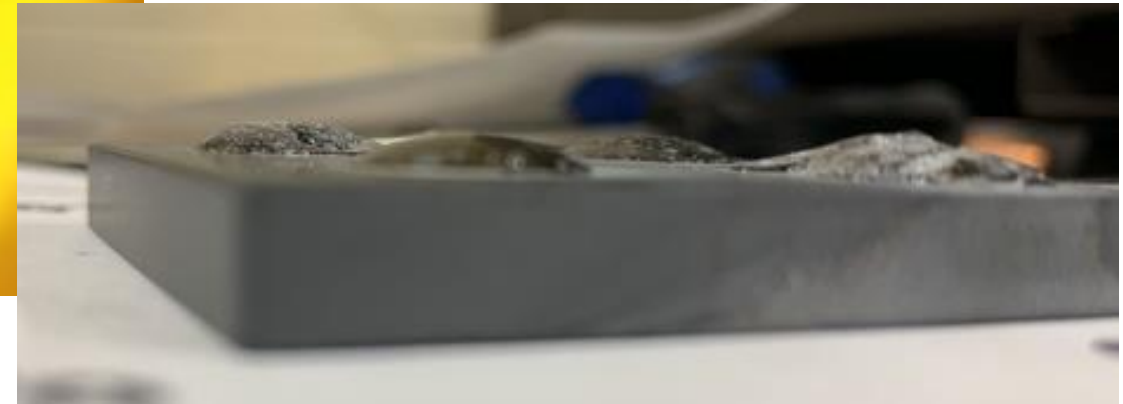
- ▶ Selling the developed product to basalt and glass fiber manufacturers

# Results

- ▶ Geosurvey results
- ▶ Test melt furnace
- ▶ Optimal wetting angles on Pt and SiC



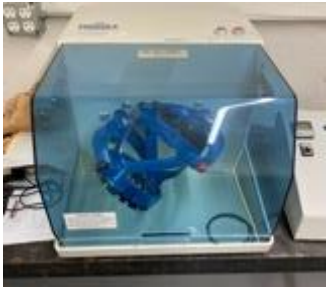
Photos and chart by Neuvokas Corporation





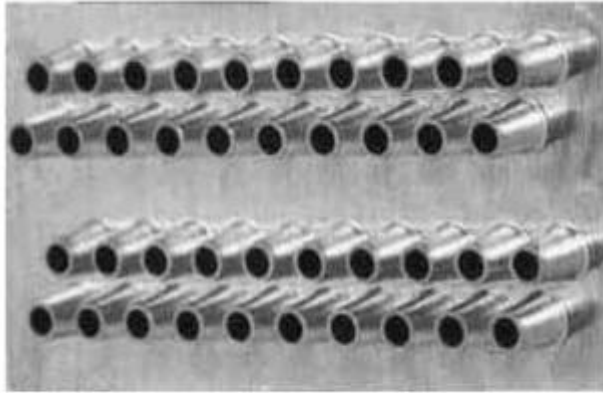
# Challenges

- ▶ Condensing the selected materials
- ▶ Identifying and eliminating failure modes to discover what works and why
- ▶ Developing first customers/development partners



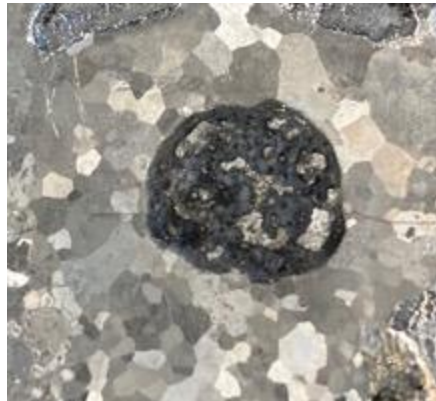
Photos and chart by Neuvokas Corporation and Loukus Tech

# Concept - Platinum to Advanced Ceramic



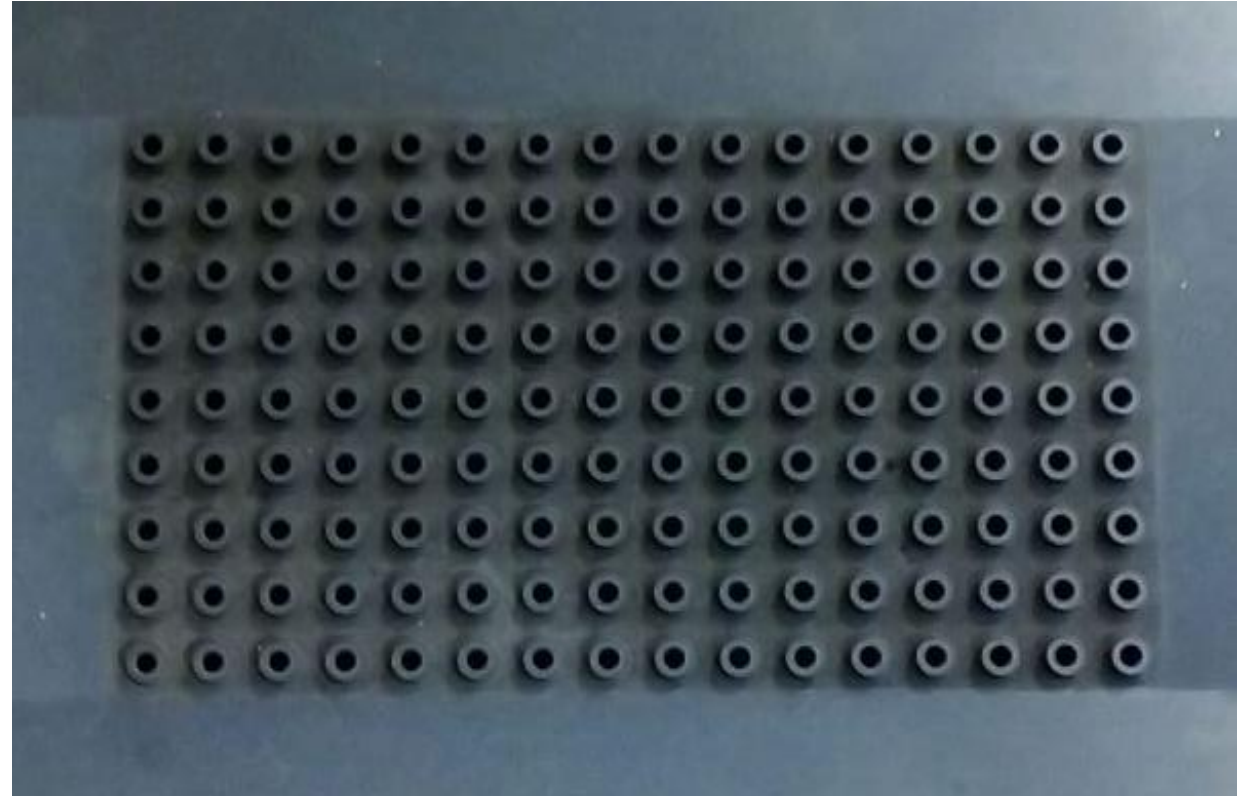
Typical Platinum/Rhodium bushing tips

Photos Elam Leed, Johns Manville, US National Science Foundation (DMR-0844014)



Grain Growth seen in Platinum plate cycled to 1700C with melted Basalt powder

Photo by Neuvokas Corporation



Sub scale bushing module planned out of candidate materials

Molybdenum disilicide-silicon nitride bushing nozzles tailor-made for basalt fibers production  
Flavio Caretto a,n, Anna Maria Laera a, Felice Di Nuzzo b, Rossella Iovino b, Francesca Di Benedetto a,  
Emanuela Pesce a, Marilena Re a, Massimo Schwarz c, Leander Tapfer a

# Candidate Bushing Materials

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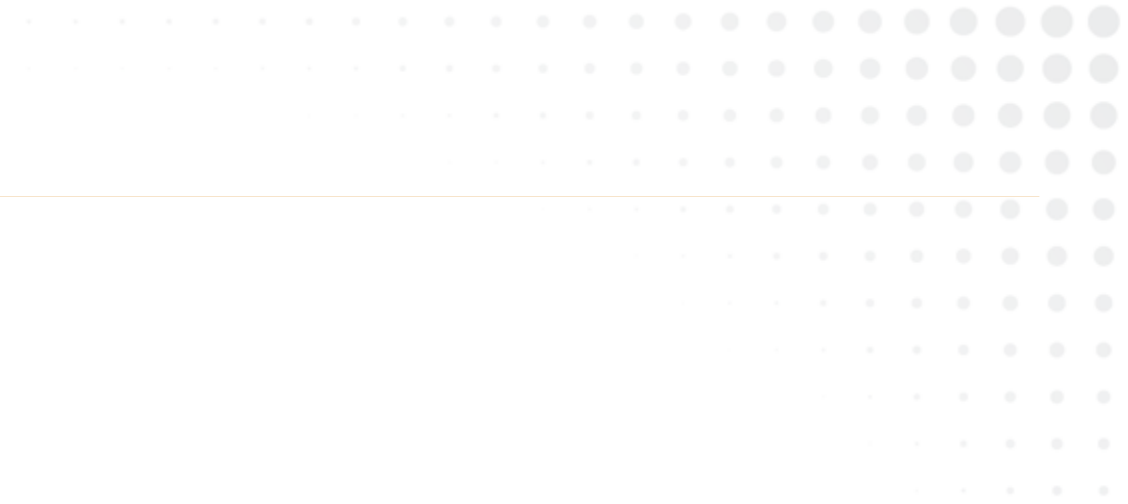


Chart from High-entropy alloy challenges and prospects, Y.F Ye, Q. Wang, J. Lu, C.T Liu and Y. Yang



# Next Steps

## Interaction Study -

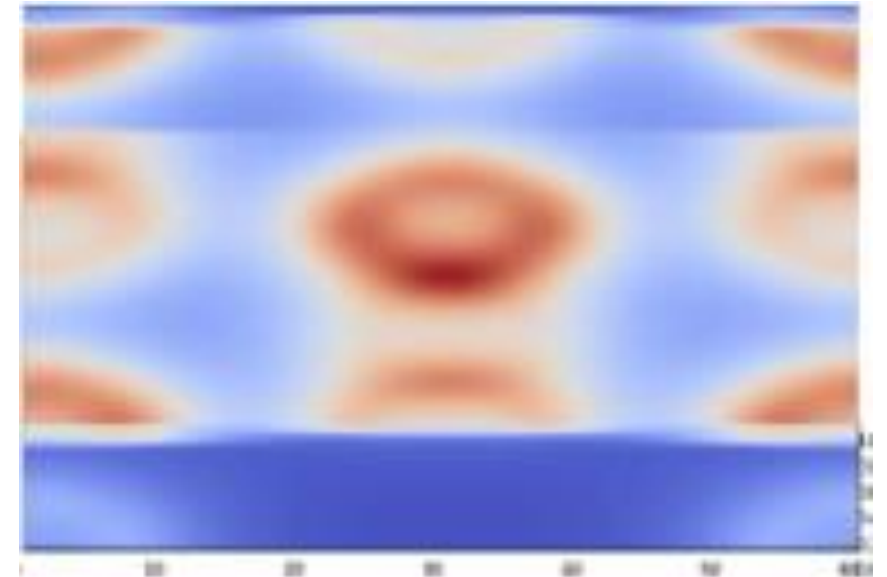
- Melt Basalt in Alumina crucible – put in a piece of the candidate bushing material (CBM) Hold at temp for several hours, let cool, dissect and examine interface
- If any interaction at basalt – CBM interface, candidate material will be rejected

## Interface Modeling -

- DFTK software – Density Functional Theory Kit
- Model surface chemistry conditions  
calibrate with data from interaction study

## Bushing Design -

- Apply Interaction Study and Interface Modeling



Model by Laurium Labs

# Potential Partnerships

- ▶ Neuvokas is developing industry partners to assist in a phase II effort for the enabling technology
- ▶ Further partnerships on the downstream offering of a low cost environmentally friendly composite rebar to replace steel at a lower cost are being cultivated as well.



U.S. Department  
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**Illinois Department of Transportation**