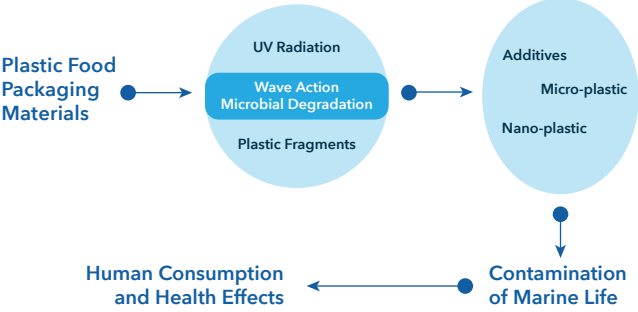


# DEGRADABLE MULTILAYER POLYMER FILMS FOR SUSTAINABLE FOOD AND BEVERAGE PACKAGING

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## THE GLOBAL PACKAGING CRISIS - MICRO-PLASTIC POISONING

Non-degradable packaging materials are a significant global and environmental concern. Non-recyclable plastic packaging materials (up to 11 layers of coextrusion) disintegrate into micro and nanoparticles, eventually entering the food chain and jeopardizing human health. We have even seen microplastics be passed from mothers to newborns.



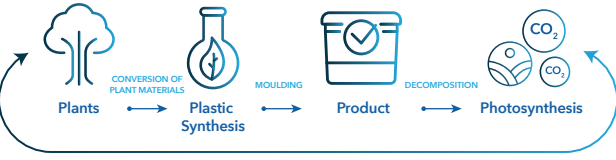
2

## DEVELOPING A BIODEGRADABLE PACKAGING MATERIAL

After disposal and composting, biodegradable polymers disintegrate and returns to nature in a reasonable time frame, leaving a minimum environmental footprint

### EXAMPLES OF BIODEGRADABLE POLYMERS

- Poly(L-lactide) (PLLA)
- Polyhydroxyalkanoates (PHA)
- Poly(ε-caprolactone) (PCL)

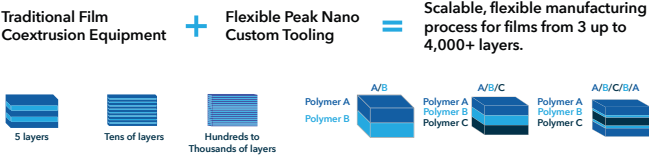


3

## PEAK NANOPLEX ADVANCED METAMATERIALS



- Developed at Case Western Reserve University
- 4096 nanolayers for application optimization
- Nanoscale unlocks new capabilities
- Enables a new level of material science



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## OHIO-BASED DEVELOPMENT & VALIDATION PARTNERS

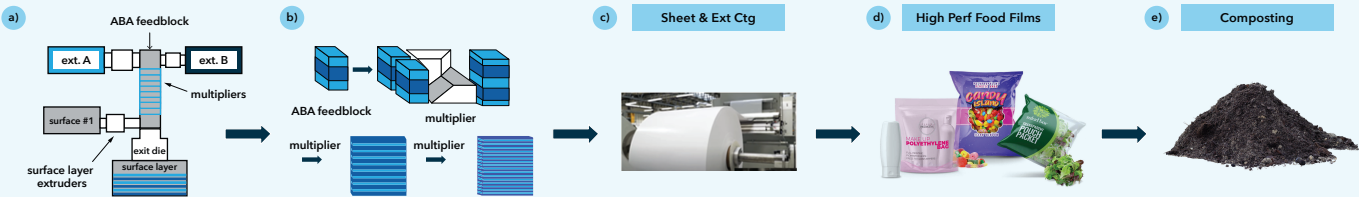
Biodegradable Nanolayer Barrier Film Development Partners



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## PROPOSED SOLUTION - NANOPLEX BIODEGRADABLE BARRIER PACKAGING FILMS

Peak nanolayer film coextrusion technology to produce biodegradable film formulations with targeted mechanical and barrier properties.



Topic: Applicant Defined Metrices	Baseline & Project Targets		State of the Art/Benchmark Based on Literature Values	
	Baseline (Project Start)	Final (Project End)		
Performance Metrics	Peak Nanolayered Barrier Film		PLA (Biodegradable non-barrier film)	PHA (Biodegradable non-barrier film)
TRL Level	3	6	NA	NA
Toughness (MJ/m <sup>2</sup> )	10	>20	2	2
Oxygen permeability (cc.mi l/m <sup>2</sup> -day-atm)	Not yet determined	<40	800	90
Water permeability (gm.mil/m <sup>2</sup> -day-kpa)	Not yet determined	<10	400	30
Biodegradability	Not yet determined	< 6 months	Degradable in industrial composting	< 6 months

### Advantages of Nanolayered Packaging:

- **Enhanced film oxygen barrier**
  - Coextrude polyvinyl alcohol (PVOH) with PLLA/PHA
  - **Why:** Increase product shelf life by preventing oxygen ingress; current standard is multilayered, multipolymer, non-recyclable film
- **Enhanced film water vapor barrier**
  - Coextrude PCL with PLLA/PHA.
  - **Why:** Increase product shelf life by nanolayer-confined PCL to decrease moisture/water vapor transport
- **Enhanced film toughness or reduces brittleness**
  - Micro/nanolayer coextrusion of PLLA, PHA, PCL, and PVOH with biaxial orientation
  - **Why:** Improve the mechanical robustness of the product to facilitate optimum film conversion and food/medical product packaging

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## PROGRAM DELIVERABLES

- Prototype, biodegradable nanolayered film systems and samples demonstrated in production-relevant environments
- Commercial evaluation and biodegradability studies by packaging partners
- Demonstrated benchmark nanolayered, biodegradable film properties
- Product data sheets created for biodegradable nanolayer film properties (O2/water vapor barrier, mechanical toughness, etc.) vs. state-of-the-art non-biodegradable packaging film properties
- Publish technology scale-up plan with cost models for continued commercialization activities and film supply to circulate with partners and additional U.S.-based packaging companies.

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## PEAK IS DRIVING OHIO JOBS

- New 275K SQFT plant in NE Ohio in 2027
- 250 New R&D and STEM jobs in Ohio
- 100+ STEM Co-ops over the last 10 years
- Invented and made in Ohio

