Award DE-EE0003916

Advanced Insulation for High Performance Cost-effective Wall, Roof and Foundation Systems

Principal Investigator
Dr. Stéphane Costeux
The Dow Chemical Company
200 Larkin Center
Midland, MI 48674
Ph. 989-636-6424
sccosteux@dow.com

Project Manager
Dr. Shana Bunker
The Dow Chemical Company
200 Larkin Center
Midland, MI 48674
Ph. 989-636-4131
sbunker@dow.com

Administrative Contact
Mitchell G. Dibbs
The Dow Chemical Company
1776 Building
Midland, MI 48674
Ph. 989-636-1202
mgdibbs@dow.com

DOE Building Envelope Roadmap Workshop, San Antonio, TX, June 26th 2012

Project objectives & scope

To explore and develop high performing insulation with

- increased R/inch, with a target of > 7.5/inch, with little or no loss over time.
- low impact on environment, utilizing no HCFC or HFC (mainly CO_2)
- good fire performance (target class A)

facilitating design of highly insulating building envelope systems

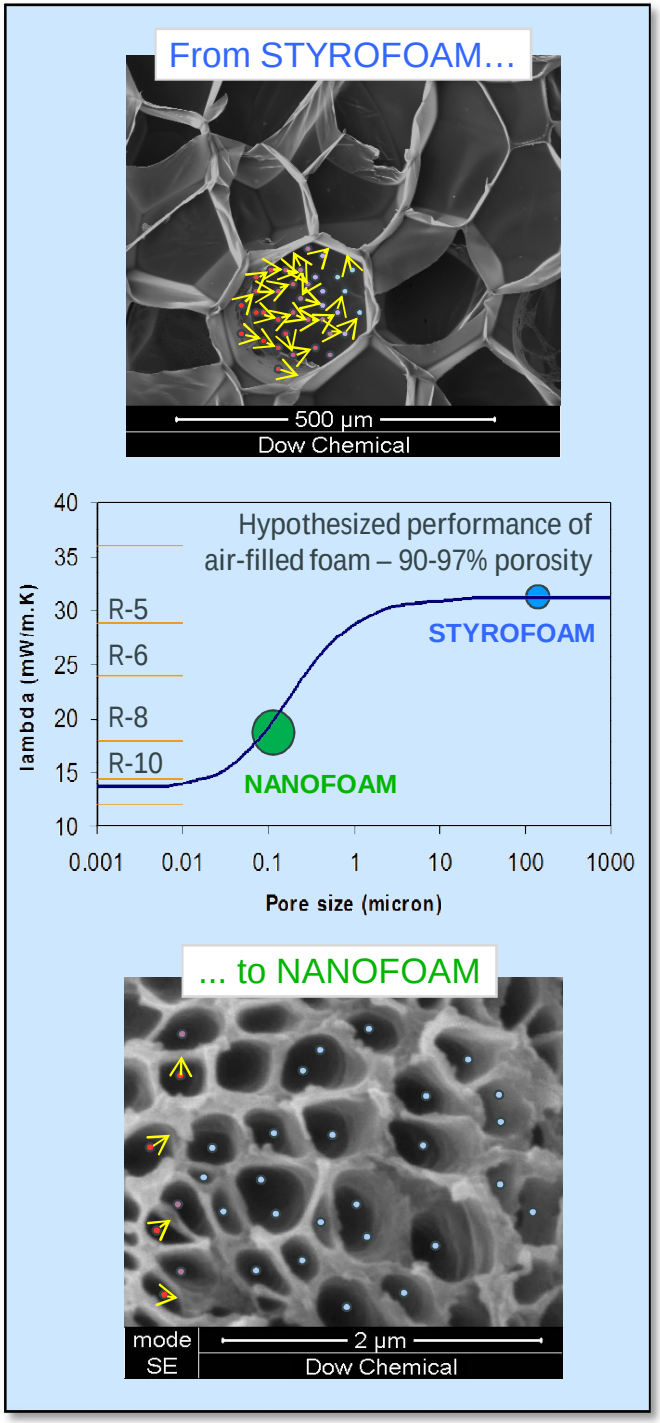
Benefit over building envelopes with equivalent performance made with materials available today

- thinner continuous insulation than XPS, EPS, ISO
- greater durability / lower cost than VIP, aerogel
- lower overall system cost (4" stud, standard doors, roof overhang)

Scope of work to include

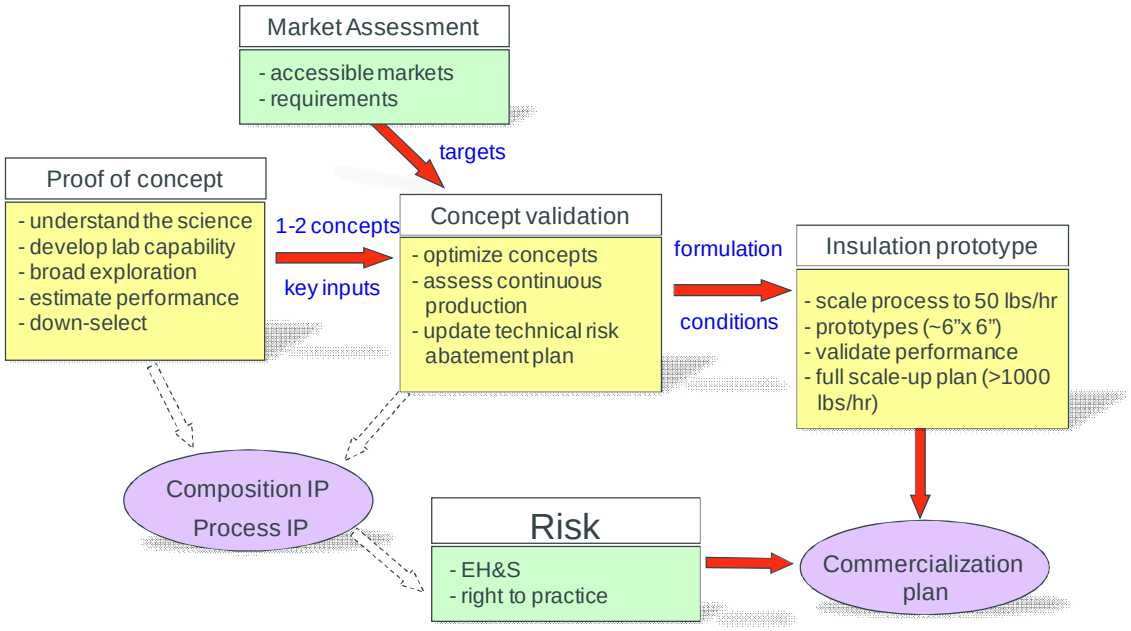
- analytical measurement techniques development
- lab scale batch foaming for formulation identification
- pilot scale semi-/continuous process development
- market assessment of opportunity by sector and application
- commercialization strategy development

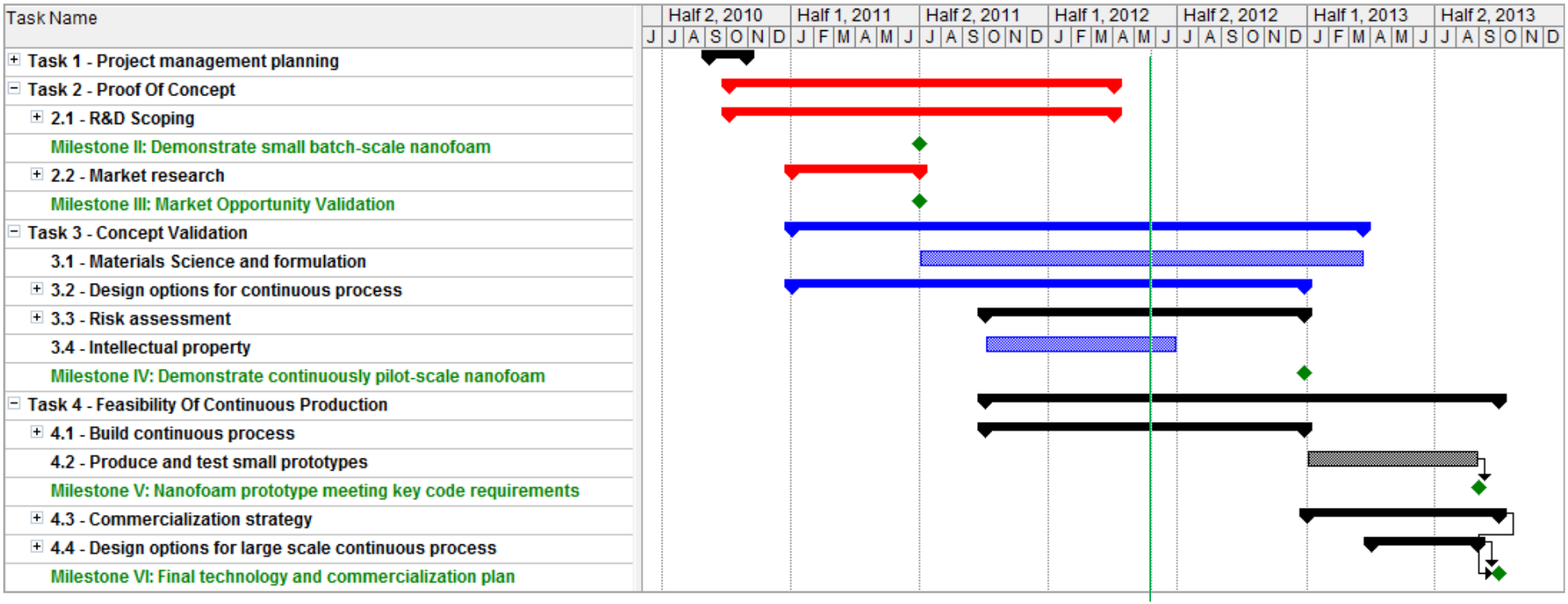
Total Funding	U.S. DOE	Dow Chemical	Cost Share	Duration
$5,910,312	$2,955,156	$2,955,156	50%	36 months



Project plan

- From concept to prototype
- Markets and opportunity
- EH&S assessment and patents
- Scale up plan



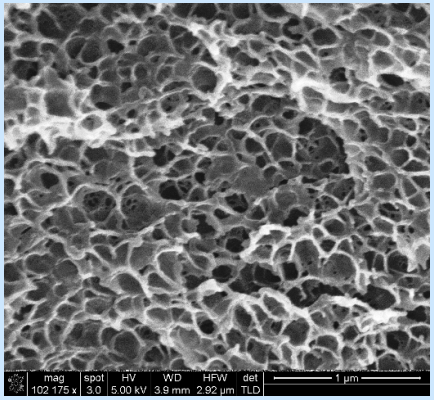


Progress to date

Project Milestones to-date	Task	Target Date	Completion Date
I- Project Management Plan completed	1	08-01-2010	10-18-2010
II- Produce a small batch-scale nanofoam meeting minimum requirement for insulation performance target (100nm/80% or R/7.5)	2.1	07-01-2011	6-30-2011
III- External validation of market opportunity and identification of additional nanofoam physical properties critical to product success	2.2	07-01-2011	6-17-2011

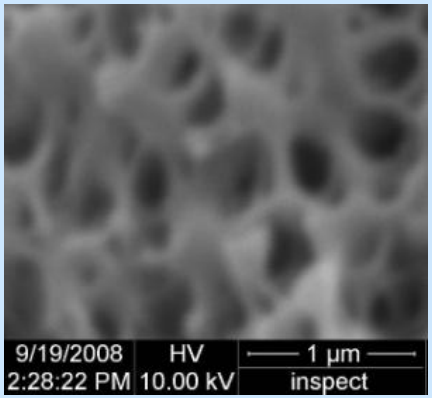
Highlights (past 12 months):

- Demonstrated 100 nm/80% nanofoams with both model polymers and commercially available resins
- Improvement of fundamental understanding of nanoscale technology (foaming, analytical and modeling)
- Pilot scale continuous line development in progress
- Initial market study completed; highlighted need for incentives to accelerate adoption in residential and commercial walls



Milestone II – Nanofoam
Example of an acrylic foam made from a commercial polymer by batch foaming.

Cell size average: ~ 90nm
Porosity: ~ 80%

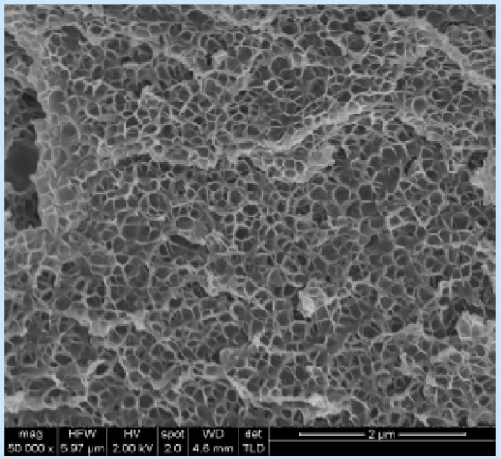


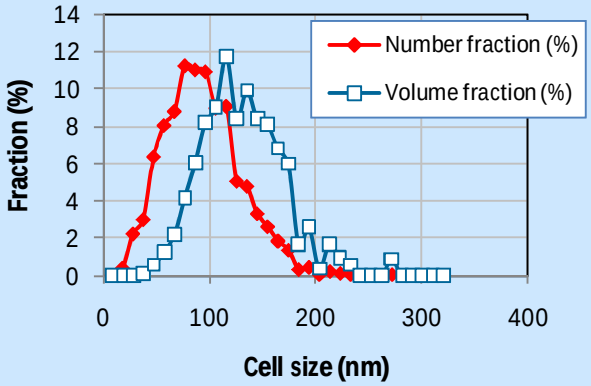
Baseline performance (2009)
Foam made from acrylic polymer at the time the project was proposed
Cell size average: ~ 250nm
Porosity: ~ 60%
Same scale as above.
Source: Dow Proposal No. 09081739

Dow nanofoams

Differentiation:

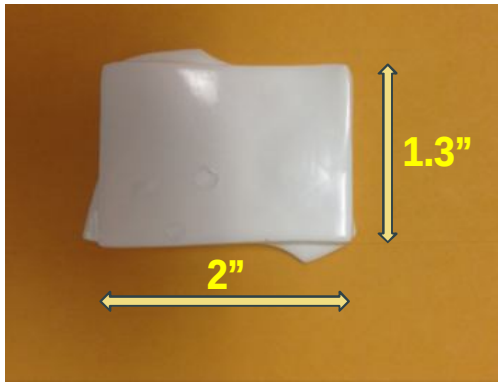
- Density 3-5 times as low as previous nanofoam attempts (films and membranes)
- 100 times more cells than other micro/nanofoams
- Commercial polymers ($1-3/lb)
- Several patents filed

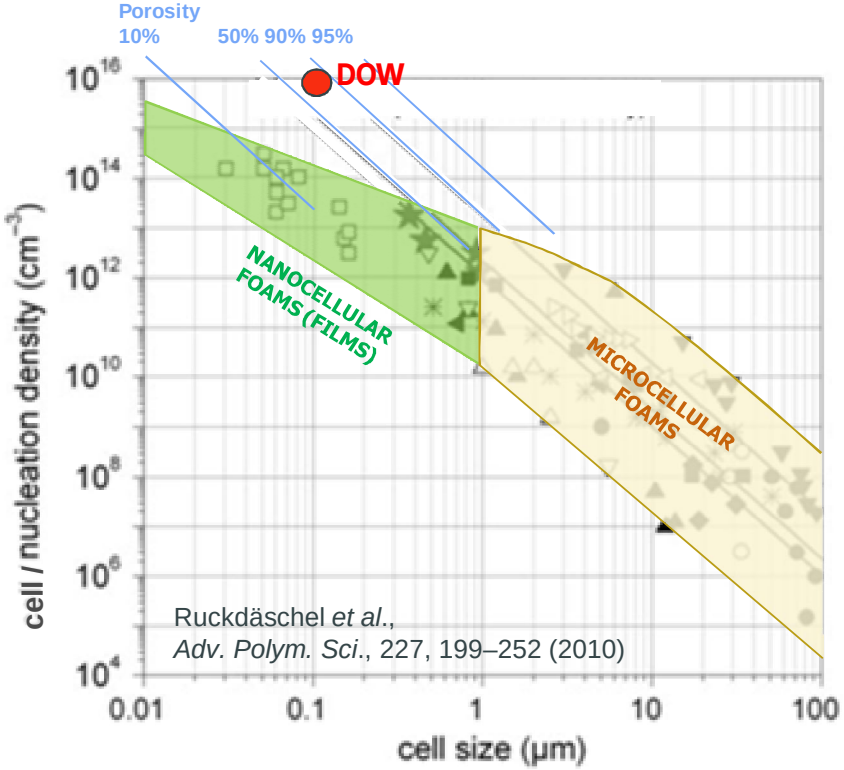




Current limitations:

- Reliable testing of R-value requires larger , flat samples (min. 4”, 6” preferred): current process limited to 1 to 2” samples.
- Higher pressure process than conventional foam process: modifications to extrusion foaming equipment needed
- Higher porosity will further reduce cost





Path forward

Project Milestones	Task	Target Date	Completion Date
IV- Produce a continuous/semi continuous nanofoam meeting minimum requirement for insulation performance target (100nm/80% or R/7.5), validated at the miniplant scale (< 5 lbs/hr)	3	12-31-2012	In progress
V- Demonstrate that the nanoporous insulation materials meet key code requirements based on 4" to 6" prototypes	4	09-01-2013	Task not started
VI- Final technology and commercialization plan	4	09-30-2013	Task not started

2012:

- maximize cell density with lowest cost polymers
- flame retardant development
- develop process on continuous foam line
- IP strategy (file key patents)
- risk assessment (technical, commercial)

2013:

- produce 4" panels for R-value and other testing
- design of commercial scale production facility
- technology commercialization plan

Panel production equipment (in pre-testing)