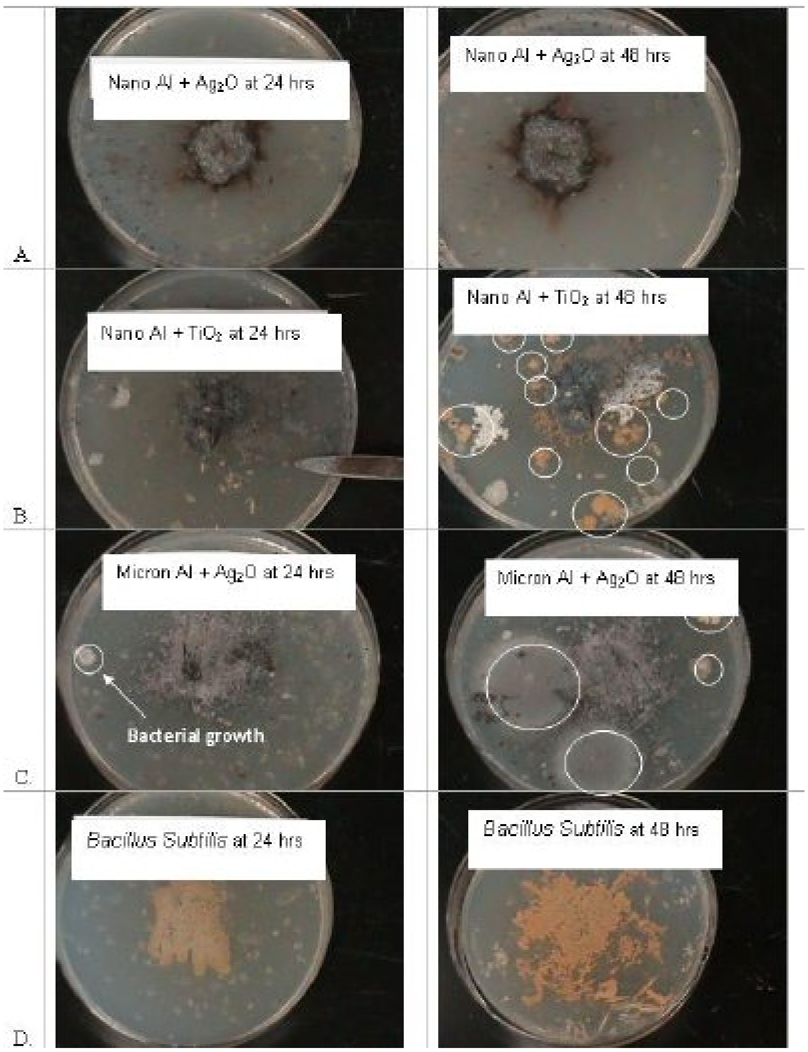
Nanostructured Aluminum Foam Sandwich Panels [1]



Aluminum-foam sandwich (AFS) panels are made from aluminum foam sandwiched between two or more panels composed of metal, polymer, stone, or fibers depending on the application. They can also be made of honeycomb [2]-latticed aluminum sandwiched between two or more layers of materials [3]. Aluminum foam on its own is not a structural element, but when combined with other materials [3] it makes a lightweight material with strong tensile strength that can withstand high shear and stress forces. The properties of the foam also enable it to absorb impacts comparable to polymer foams in a much smaller cross-section[1].

A major challenge in creating closed cell aluminum foam has been creating vesicles uniform enough to consistently distribute impacts and bear loads evenly[1]. Recent developments in metallurgy have enabled manufacturers to develop uniform, nanostructured aluminum and aluminum alloy foams for use in future materials [3] such as AFS panels. Aluminum alloy foams can be manipulated at the nano scale during the fabrication process to enhance or introduce specific properties not previously inherent in aluminum foam. These can be added attributes such as antimicrobial [4] or antibacterial [5] properties to enhance the AFS for certain applications[2].

Aluminum foam is manufactured in a process called combustion synthesis [6]. The aluminum alloy foams manufactured in this process are created by mixing aluminum with other metal nano-powders and gasifying agents, which are then pressed into pellets. Lasers are then used to ignite the pellets, starting the chemical reaction that forms the foam. This foam is then incorporated into various materials [3], including AFS, which are then used in applications ranging from architecture to aerospace and defense [7]. These nano-structured AFS panels can offer aesthetic appeal, fireproofing, microbial protection[2], sound dampening, increased strength, and reductions in structural engineering considerations when applied in architectural applications[1].

References

1. Roush W. **Aluminum Foam: This new technique for producing aluminum foam with uniform cells could make thinner impact-absorbing products** [8]. [Internet]. Submitted . Available from: http://www.technologyreview.com/article/406080/aluminum-foam/ [9]
2. Hunt EM. **Nanostructured Metallic Alloys?Materials for the future** [10]. [Internet]. Submitted . Available from: http://www.azom.com/article.aspx?ArticleID=5552 [11]

Author:

Tai Wallace [12]
Evan Taylor [13]

Product Name:

- Cellular Aluminum [Metcomb Nanostructures] [14]

Development Stage:

- Available, but not Ubiquitous [15]

Key Words:

- Aluminum Foam Sandwich Panels [16]
- Honeycomb [2]
- Nanostructured Metal Alloys [17]
- Combustion Synthesis [6]

Mechanism:

- Passive Nanostructure [18]

Summary:

These nanostructured aluminum-alloy foams have improved load bearing and structural characteristics over existing aluminum foams. Additionally, the advancements in metallurgy and manufacturing nanostructured metal foams is facilitating the development of novel characteristics in aluminum and metal alloy foams. Aluminum foams of the future will be customizable for very specific needs and applications.

Function:

- Strengthening Construction Materials [19]

Source:

Nanostructured Metallic Alloys?Materials for the future [10]

Material:

- Aluminum [20]
- Copper [21]
- Oxygen [22]
- Silver [23]
- Titanium [24]

Source:

Nanostructured Metallic Alloys?Materials for the future [10]

Source:

Nanostructured Metallic Alloys?Materials for the future [10]

Benefit Summary:

This technology has the potential to improve energy and resource efficiency in the built environment as well as improve environmental health [25] and safety in certain applications.

Benefit:

- Resource Efficiency [26]
- Health [27]
- Safety [28]

Risk Summary:

The risk lies in the metallic nanopowders and chemicals used in the fabrication of these foams. The specific environmental and human health [25] risks would depend largely on the type of nanomaterials used, but would be limited to the manufacturing and fabrication stage. Once the foams have been manufactured through combustion synthesis [6], the risks are nil. The foam itself would be completely recyclable, and all of the nanoparticles [29] would be aggregated into a solid form.

Risk Characterization:

- Ambiguous [30]

Risk Assessment:

- Ecological Risks [31]
- Health Risks [32]

Source:

Aluminum Foam: This new technique for producing aluminum foam with uniform cells could make thinner impact-absorbing products [8]

Facility:

- Construction Materials [33]
- Defense & Security [34]

Source:

METAL AND POLYMER FOAM HYBRID MATERIALS: DESIGN, FABRICATION AND ANALYSIS [35]

Activity:

- Panelling [36]

Substitute:

- Existing Material [37]

Challenge Area:

- Resource Consumption [38]

CNS-ASU research, education, and outreach activities are supported by the National Science Foundation under cooperative agreement#0937591.

Source URL: http://nice.asu.edu/nano/nanostructured-aluminum-foam-sandwich-panels-0

Links:
[1] http://nice.asu.edu/nano/nanostructured-aluminum-foam-sandwich-panels-0
[2] http://nice.asu.edu/keywords/honeycomb
[3] http://nice.asu.edu/keywords/materials
[4] http://nice.asu.edu/keywords/antimicrobial
[5] http://nice.asu.edu/keywords/antibacterial
[6] http://nice.asu.edu/keywords/combustion-synthesis
[7] http://nice.asu.edu/keywords/defense
[8] http://nice.asu.edu/biblio/aluminum-foam-new-technique-producing-aluminum-foam-wit
[9] http://www.technologyreview.com/article/406080/aluminum-foam/
[10] http://nice.asu.edu/biblio/nanostructured-metallic-alloys%E2%80%94materials-future
[11] http://www.azom.com/article.aspx?ArticleID=5552
[12] http://nice.asu.edu/users/tai-wallace
[13] http://nice.asu.edu/users/evan-taylor

[14] http://nice.asu.edu/product-name/cellular-aluminum-metcomb-nanostructures
[15] http://nice.asu.edu/development-stage/available-not-ubiquitous
[16] http://nice.asu.edu/keywords/aluminum-foam-sandwich-panels
[17] http://nice.asu.edu/keywords/nanostructured-metal-alloys
[18] http://nice.asu.edu/mechanism/passive-nanostructure
[19] http://nice.asu.edu/function/strengthening-construction-materials
[20] http://nice.asu.edu/material/aluminum
[21] http://nice.asu.edu/material/copper
[22] http://nice.asu.edu/material/oxygen
[23] http://nice.asu.edu/material/silver
[24] http://nice.asu.edu/material/titanium
[25] http://nice.asu.edu/keywords/health
[26] http://nice.asu.edu/benefit/resource-efficiency
[27] http://nice.asu.edu/benefit/health
[28] http://nice.asu.edu/benefit/safety
[29] http://nice.asu.edu/keywords/nanoparticles
[30] http://nice.asu.edu/risk-characterization/ambiguous
[31] http://nice.asu.edu/risk-assessment/ecological-risks
[32] http://nice.asu.edu/risk-assessment/health-risks
[33] http://nice.asu.edu/facility/construction-materials
[34] http://nice.asu.edu/facility/defense-security
[35] http://nice.asu.edu/biblio/metal-and-polymer-foam-hybrid-materials-design-fabrication-and
[36] http://nice.asu.edu/activity/panelling
[37] http://nice.asu.edu/substitute/existing-material
[38] http://nice.asu.edu/challenges/resource-consumption