REALISING THE POTENTIAL OF POROUS METALS

OVERVIEW: **A new, very versatile means of making metallic materials with fine, open, inter-connected pores, offering tight control over pore size, density and distribution.**

TECHNOLOGY: **LOST CARBONATE SINTERING™**

Potential
Volume for volume, porous metals are significantly lighter than their bulk metal equivalents.

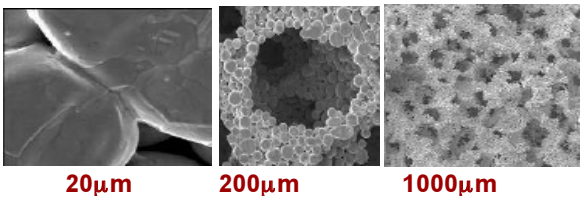
Their porosity can also confer valuable attributes, provided it is closely controlled.

Obstacle
Techniques currently used to produce porous metals (melt-gas injection, melt foaming, melt infiltration, powder foaming, investment casting, metal deposition, metal gas eutectic method, sintering hollow metal spheres) have significant disadvantages. Some produce only closed cell materials; some require the use of expensive materials; some are labour-intensive; some are only suitable for metals with low melting points.

Methods suitable for a wider range of metals and their alloys are generally expensive. There are relatively low-cost methods, but they offer poor control over the size and distribution of the pores, or the porosity range obtainable is very narrow. Investment casting offers greater controllability, but it is a high-cost method.

Solution
Lost carbonate sintering™ (LCS) has none of these disadvantages. It involves 6 simple steps:

1. combining metal particles with non-metal particles and a binder;
2. compressing the mix beyond the yield strength of the metallic particles;
3. heating the mix sufficiently to evaporate the binder;
4. heating it further to make the metal particles adhere to each other without melting;
5. cooling the mix;
6. removing the non-metal particles by dissolving them.



Bonding between particles in porous copper made using LCS

Porous copper disk made using LCS

FEATURES & BENEFITS:

Raw materials
LCS …
- works with most metals/metal alloys;
- easily accommodates metal particles measuring 5-500 microns – but can work with particles up to 1.5mm in diameter, if required;
- uses cheap, widely available, water-soluble carbonates as the non-metal component.

Process
LCS is …
- relatively inexpensive;
- amenable to automation;
- capable of creating net-shape metal foam components.

Output
LCS …
- can achieve the precise porosity required, from a minimum of 50% to a maximum of 90%;
- creates open, interconnected pores;
- produces robust materials capable of use in hostile environments.

APPLICATIONS AREAS & MARKETS:

Absorption/insulation

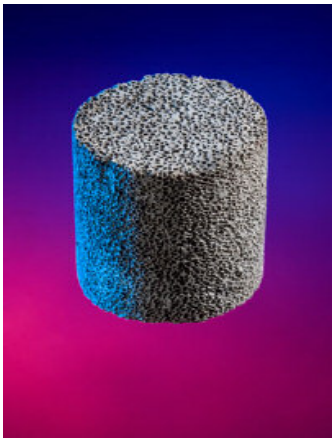
- thermal insulation
- sound absorption
- impact/energy absorption
- electrical screening

Conductivity

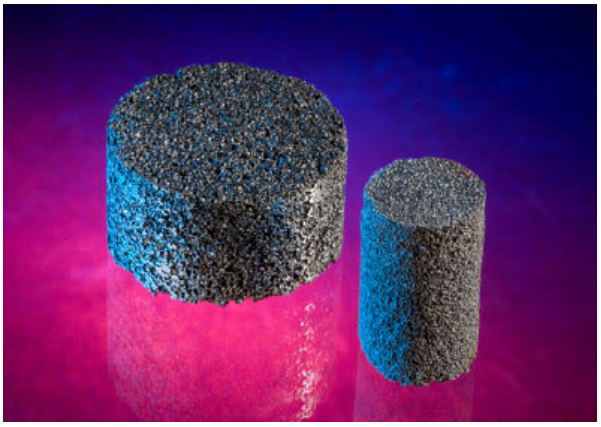
- macro-scale products/components based on heat exchange (*e.g.* radiators, air conditioners, refrigerators)
- micro-scale exploitation of heat-exchange capabilities (*e.g.* personal computers)

Structural applications

- lightweight/sandwich structures
- catalyst supports
- filtration
- a range of biological applications

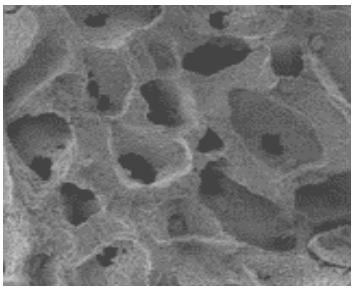


Porous steel bar created using LCS



Porous steel disk and aluminium bar created using LCS

Titanium foam created using LCS



INITIAL EVALUATIONS:

Sound absorption

Preliminary studies conducted by the University's Acoustics Research Unit indicate that metal foams created using LCS perform at least as well as conventional sound insulation materials – and have the added advantage that they can be deployed in hostile environments.

Conductivity

Preliminary studies conducted by Manchester University on porous metals created using LCS have identified the optimum pore size, structure and density required for heat transfer/exchange.

SMOOTHING THE PATH FROM THE LAB TO INDUSTRY/THE MARKET:

The research team at the University are looking for industrial partners to further develop and exploit the technology. Potential collaboration routes include:

- PhD projects
- collaborative research (with potential to harness public funding)
- targeted contract research for individual organisations
- licensing opportunities

FURTHER INFO:

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