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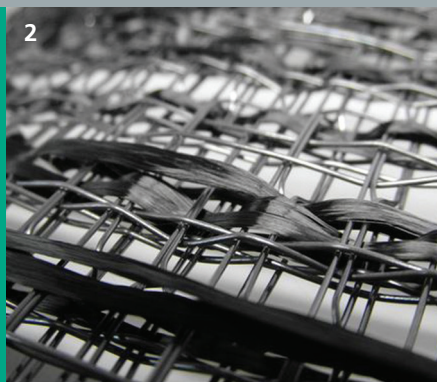

1 *Close-up of a 3D wire structure - strucwire®*
2 *Close-up of a woven 3D wire-carbon fibre structure*

3D WIRE STRUCTURES

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TECHNISCHE UNIVERSITÄT DRESDEN

KIESELSTEIN WIRE SOLUTIONS

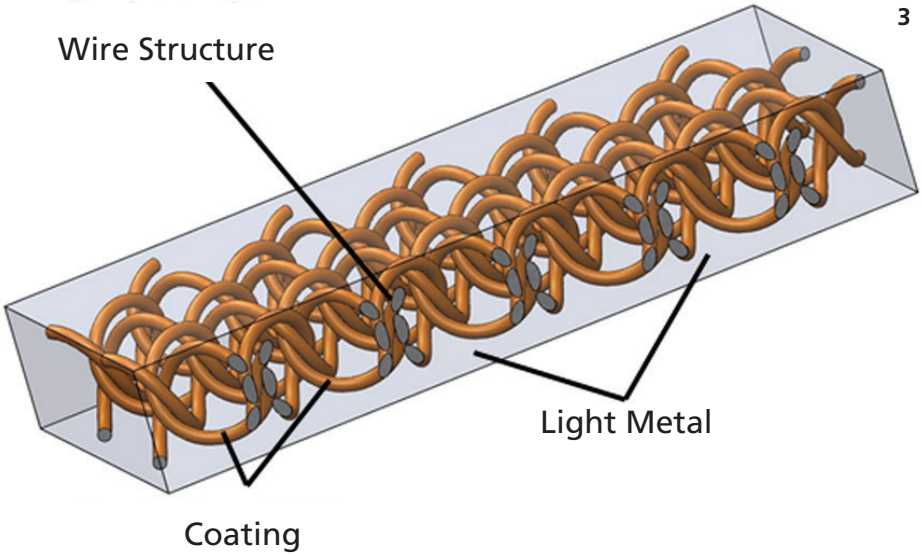
ITM Institut für Leichtbau und Kunststofftechnik

The Dresden Branch of the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM is specialised in composite and gradient materials, functional materials as well as highly porous metals. Over the last years, a lot of investigations have been carried out to develop new lightweight materials like 3D wire structures with a uniform cell structure and the feature for structural calculations. Cellular materials are interesting candidates for weight saving due to the fact that the introduction of pores into the materials lowers the density significantly. These highly porous materials also possess combinations of properties which are not possible to achieve with other materials.
A new type of these materials are so-called three-dimensional wire structures which are characterized by a wide range of pore sizes and structural densities.
These 3D wire structures offer new opportunities in the field of lightweight construction especially.

By variation of wire diameter and pore size a large scope of applications is possible. Interesting fields of applications are explosion protection and heat exchangers, acoustic absorption, heat insulation, energy absorption, damping or catalytical effects. Biomaterials will be a new innovation area in which the mechanical requirements of the bone can be adapted by a combination of isotropic and anisotropic wire structures.

Manufacturing & Materials

The cellular lightweight structure „strucwire®“, developed and patented in cooperation with KIESELSTEIN, can be manufactured from almost every wire material and allows a variation in cell width and geometric dimension.
A combination of different wire materials in one structure can be fabricated.



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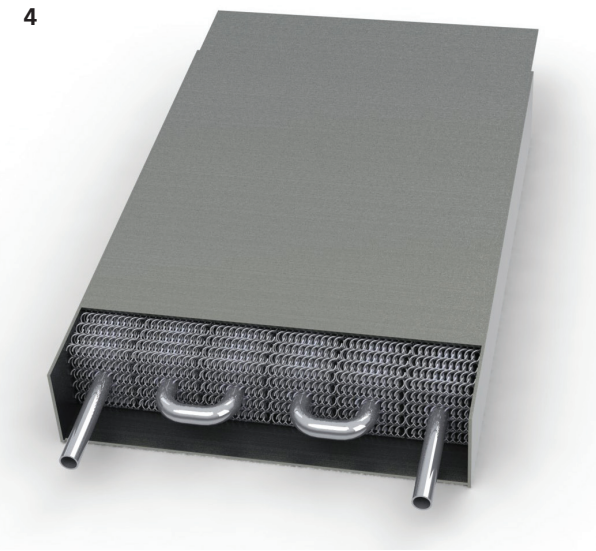

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The wire cross points or nodes are interconnected by brazing, soldering, adhesive bonding or sintering.
Possible wire materials are steel, aluminum, copper or titanium. Mesh sizes are avaiable in 1, 3, 5, 10 and 20 mm.

Properties

- Low density: 0.1 - 1.5 g/cm³
- Producible from all wire materials
- High specific strength
- Open-cell structure - permeable
- Temperature stability
- Anisotropic
- Calculable (Simulation FEM)
- Stiffness (tailored): 150 MPa - 3,000 MPa
- Offset yield strength: 10 - 50 MPa (brazed)
- Energy absorption: ~ 10 - 30 MJ/m³

Potential Applications

Examples for applications are sandwich structures for containers, multifunctional lightweight elements for building construction or absorber materials for crash-boxes. Furthermore, 3D wire structures in combination with phase change materials (PCM) are excellent candidates for high performance heat storage devices for higher operating temperatures (Picture 4). A new potential is the local integration of wire structures in light metal casting components to reinforce and increase the fracture toughness compared to their unreinforced counterparts (Picture 3).

R&D Services

- Development of 3D wire structures based on different metals and alloys
- Joining of the wire structures by brazing, soldering, adhesive bonding and sintering
- Characterization and testing of properties
- Development of complex components / prototypes based on 3D wire structures
- Simulation and design of parts
- Manufacturing of prototypes and small scale production

References / R&D Projects

- Longtime know-how on this topic (also hybrid structures)
- Experience in joint research projects (SAB, BMBF, other)
- Networking with producers, research institutes and other partners

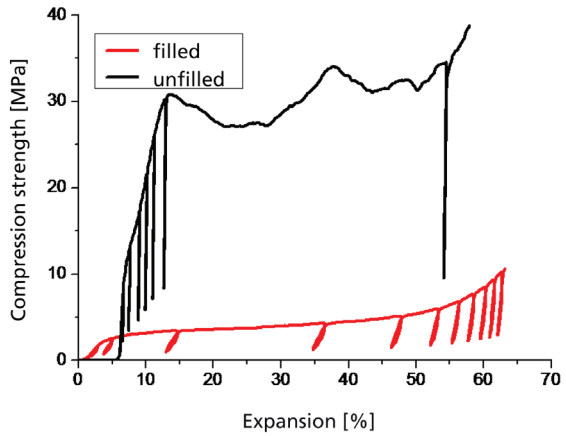

Figure 1
Influence of material joining on compression strength

3 *Coated 3D wire structure (strucwire®) as reinforcement insert for light metal casting*

4 *PCM heat storage device based on 3D wire structures*