Metal foams - The revolutionary material set to transform industries

Metal foams are an interesting type of materials. They have very unique properties which are beneficial as compared to solid metals in some cases. They are fairly uncommon in the market, partly because it is difficult to control their manufacturing processes. The process of creating models which mimic their appearance and behaviour is therefore of interest.

Metal foams are a fairly new type of metallic materials. In appearance, they look very similar to a sponge used for everyday cleaning. The difference is that this sponge is made out of metal which provides it with extraordinary properties. Lightweight, thermal insulation, and energy-absorption capabilities are just a few examples [1].

Since they posses such unique properties, it is interesting to discover both why and how this is the case. Finding why would also prove useful to see if these materials have the possibility to replace solid metals. The reason for them having such unique properties can be partly explained by their structure which is mostly determined by manufacturing processes.

They are mainly manufactured by a mixing of different reagents; either a metallic liquid with gases or multiple compressed powders. By a heating and subsequent cooling of the mixed reagents, the foam material is formed. The final product looks very similar to the porous part of a human bone, part structure, part bubbles [2].

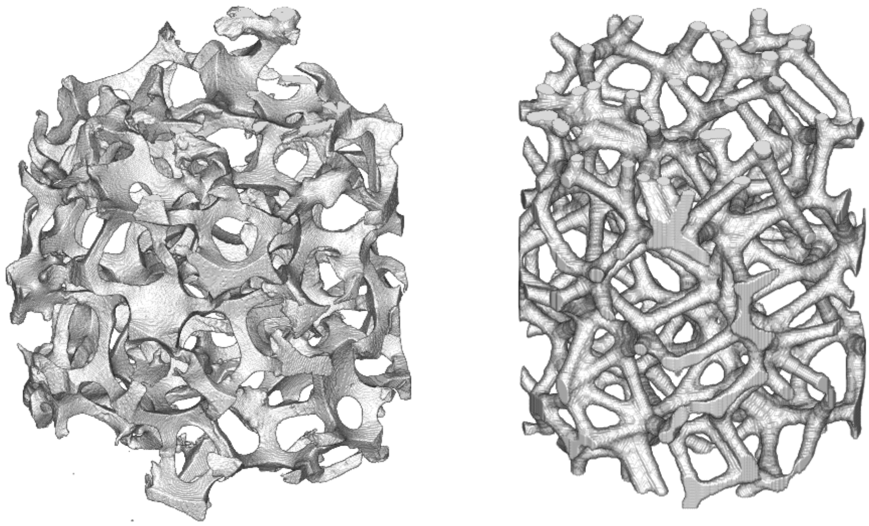
The bubbles, also called pores, are placed somewhat randomly during the manufacturing process. This means that any other foam material created with the same procedure will be different. In turn, it does not allow for any major control over the shape of the final foam sample.

To solve this, a possible solution is to create numerical models which look and behave like real foams. Such models are often called architectured foam models since they are designed by human hand. They are created by combining different algorithms [3]. Preferably, they should also allow for control over the exact appearance of the final foam model which is not possible with classic processes.

The algorithm used in this project is based on initially throwing overlapping spheres in a box. Any overlap is removed by the moving and shrinking of the spheres. This creates a box with tightly packed spheres. The packing is used together with additional methods to generate an architectured foam model. These methods try to mimic the nature of real foams by using different tricks. One trick is to create a foam which minimizes the distance between spheres.

The intersection between spheres constitutes the model [4].

To determine how good of a fit the architectured foam model is to reality, a scanned real foam sample is used. An example of this is shown in the figure below.



(a) Real foam sample. (b) Architectured foam sample.

Figure 1: Real foam sample and architectured foam obtained from algorithms.

Based on results obtained in this project, the final architectured foam looks and has a similar structure as the real foam. The figure below shows both the real foam sample (left) and an example of a generated foam sample(right). More research is required on the topic to explore the combination of more complicated algorithms.

References

[1] P.S. Liu and G.F. Chen. “Chapter Two - Making Porous Metals”. In: *Porous Materials*. Ed. by P.S. Liu and G.F. Chen. Boston: Butterworth-Heinemann, 2014, pp. 21–112. ISBN: 978-0-12-407788-1. DOI: https://doi.org/10.1016/B978-0-12-407788-1.00002-2.

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