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A simulation-based study on mesostructured material for 3D printed flexible applications

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Materials can be classified based on their physical and chemical properties. Strength and flexibility are two important properties of materials, and they vary according to the physical shape of the material. One of the emerging technologies in the design and manufacturing field is 3D printing technology and is used to build anything from small equipment to spacecrafts. The main disadvantage of this technology is the difficulty of producing flexible structures with considerable durability. One solution that can be used to avoid this issue is to use mesostructures as the interior structure of 3D printed objects. 3D printed mesostructures can be engineered to give desired physical properties in many applications. This study analysed the flexibility and durability of PLA (Polylactic acid) plastic-based mesostructures for flexible soles for footwear. Here, the same geometric shape was used keeping the density of the shape the same with deferent types of mesostructures. The method executed in this study can be applied to design flexible and reliable messostructure-based materials in general. The mesolevel continuum-based small structures provide a basis to design material structures to suit special processing methods and applications. When designing these structures, the focus is given to the deformation limits, flexibility, and form factor requirements of the final application. As a result of the study, a PLA-based flexible mesostructured basis for soles of footwear that can withstand the weight of an adult human and is resistant to gait movements was successfully designed and simulated. The results suggest that, after considering the shape of the structure and the forces it is expected to undergo, it is possible to design structures that can withstand different types of strains and pressures to facilitate the required flexibility by carefully selecting an appropriate mesostructured material-based basis. There are many benefits of these flexible materials. For example, new wearable devices can be conveniently designed, light vehicles such as aircraft can be made more robust by making mechanical parts that are resistant to movements and shocks and special tires may also be made to replace rubber tires in special vehicles such as rovers and other robotic equipment.

Keywords: 3D-printing, flexibility, mesostructured, strength

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