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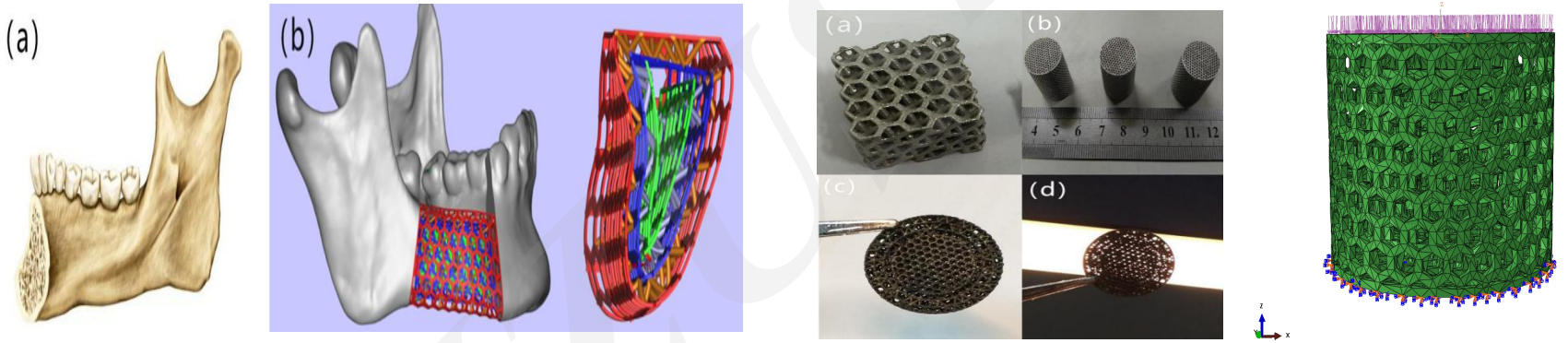
Bionic mechanical design and 3D printing of novel porous Ti6Al4V implants for biomedical applications

Key words: Layered slice and rod-connected mesh structure (LSRCMS), Porous Ti6Al4V implant, Bone defect repair, Selective laser melting (SLM), Mechanical properties, Finite element analysis

Research Summary

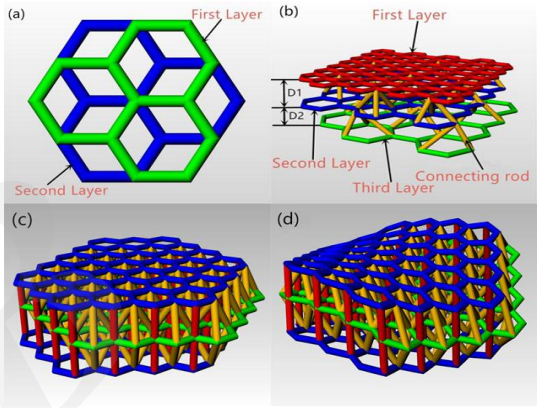
This research mainly focused on the novel porous Ti6Al4V implants for biomedical applications, which is similar to the internal structure and the mechanical properties of bone tissue and beneficial to the growth of the bone cell and the exchange of the nutrients.



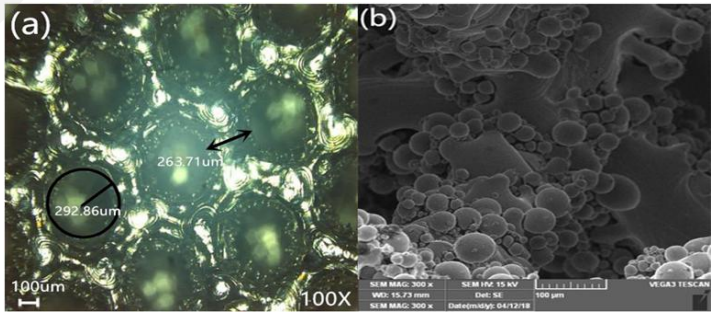
- **Design concept and method**
- **3D printing and sample structure characterization**
- **Mechanical performance analysis**
- **Finite element analysis**

Innovation points

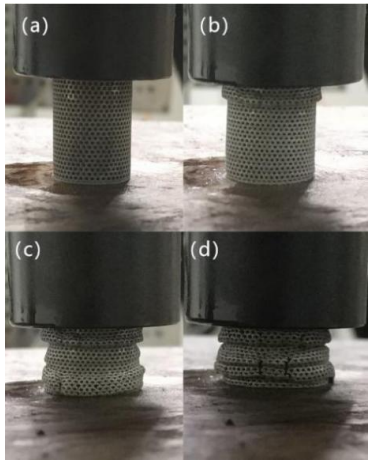
● **Proposed** the concept of " reducing dimensions, designing layer by layer ", and introduced the porous bone implants design method of the Layered slice and rod-connected mesh structure (LSRCMS).



● **The** pore diameters and strut sizes of the test samples were observed in all directions using optical microscopes, the surface were observed using SEM.

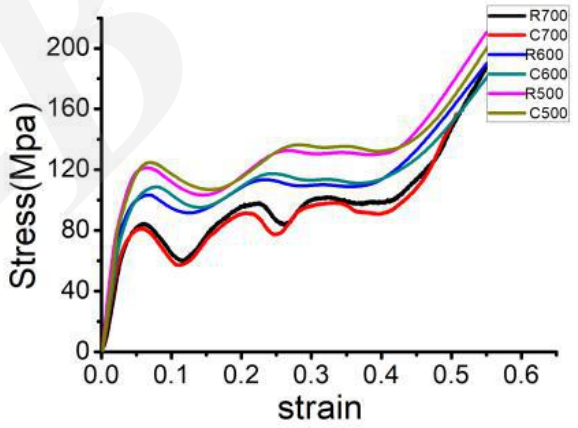


●**Evaluated** the mechanical properties such as the yield strength and elastic modulus of the LSRCMS using the Instron 8850 tester under the test standard ISO 13314:2011.

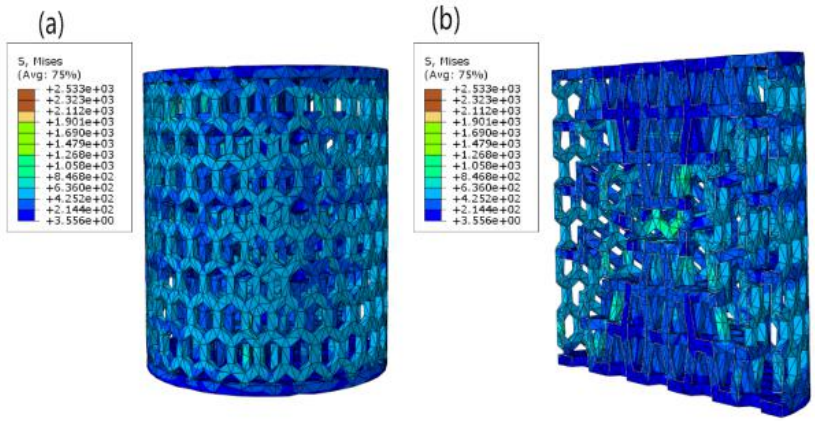


Innovation points

●**The stress-strain curve of the LSRCMS samples was unlike that of traditional porous structure scaffolds and showed a special deformation behavior in the compression process, exhibited three distinct regions. The LSRCMS maintains good structural characteristics under pressure.**



●**The simulation results also showed that with the LSRCMS, forces could gradually be transferred from the loading area to different levels of layered slices by transmission through the connecting rods, and the stress on the rod showed a higher numerical response.**



Innovation points

A series of comprehensive figures and tables were generated to illustrate the advantages and characteristics of the LSRCMS compared to traditional porous implants

Table 1 | Summary of pore structure parameters and mechanical properties of the LSRCMS specimen

Figure 7 | An SEM image of the fractured surface morphology after deformation

Figure 10 | Relative modulus and relative strength versus relative density for the LSRCMS samples