



Technology Offer

A tunable cohesive granular material

File no.: MI 0705-5158-BC

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Background

For sieving and separation purposes porous materials with adjustable sizes and shapes of the pores as well as tunable mechanical properties are required. The existing materials such as sintered materials, open-cell foams or cemented aggregates can be made porous but they are either fragile or can collapse for large deformation. Therefore, chemically inert and damage resistant porous materials with adjustable permeability as well as mechanical and geometrical properties that can sustain large deformation are highly demanded for the applications as filters, sieves or membranes.

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Technology

We offer a new technology to fabricate porous material with tunable elasticity and desired shapes and sizes. Using granules made of a stiff substance (glass) and mixing them with a small amount of an elastomeric substance (PDMS) leads to formation of the capillary bridges between the grains. The resulting mixture is cohesive and malleable, and can be poured into a mold of the desired shape. After the curing step, the solid capillary bridges between the granules are formed. The pores of this granular material can be adjusted by selecting the size and the shape of the granules. The elasticity can be easily tuned by varying the Young's modulus of the solid capillary bridges. Fig. 1 shows the granular material formed of the glass beads and PDMS.

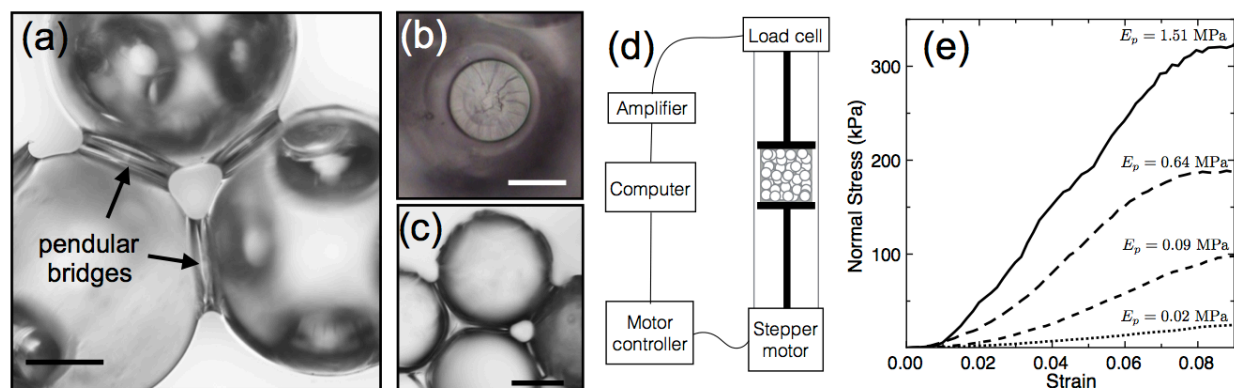


Fig. 1: (a) Three beads connected by polymer bridges. Scale bar: 500 μm . (b) Debonded bridge seen from the top. Scale bar: 50 μm . (c) Glass beads connected via pendular rings and a trimer, which consists in three merged capillary bridges, observed for polymer fraction higher than 2.7%. Scale bar: 100 μm . (d) Sketch of the uniaxial compression setup to measure the Young's modulus of the material. (e) Stress-strain curves of the cohesive granular material measured for various Young's modulus of the polymer forming the capillary bridges.

Our results show that the elastic modulus of the granular material prepared as described above can be adjusted from 1 kPa to 1.5 MPa, and that the material can be reversibly deformed for large maximal strains of about 8%. Permeability can also be finely adjusted by varying the grain sizes and polymer content. Typical measured permeability ranges from 10^{-12} m^2 (low permeability) to 10^{-10} m^2 (high permeability).



Advantages

- Variable elasticity from 1 kPa to 1.5 MPa
- Adjustable pore size and permeability
- Tunable mechanical properties
- Curable in the desired shape
- Applicability as fluid filter and membrane
- Usage of inert materials

Literature

Hemmerle, A.; Schröter, M.; Goehring, L., "A tunable cohesive granular material", arXiv:1607.07360 (under review)

Patent Information

US patent application filed in July 2016.