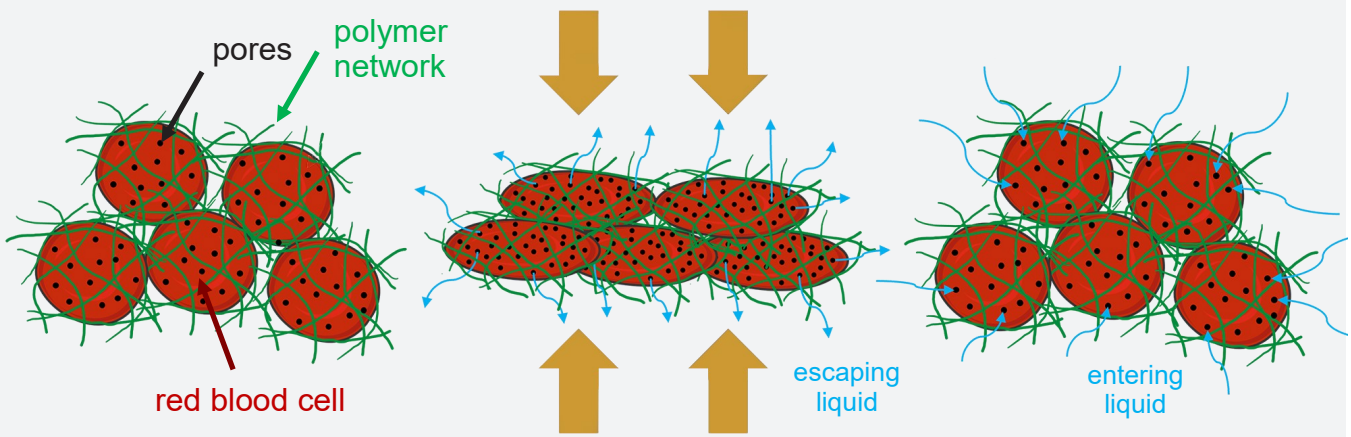
ETH zürich

Licensing Opportunity

Injectable hydrogels for minimally invasive operations



(left) before compression, the prepared red blood cells reside inside the crosslinked network as fillers, (middle) compression drives the stored liquid out of the cells, the overall volume shrinks, (right) after compression the liquid re-enters and the overall shape is restored

Application

A sponge-like hydrogel fits through a cannula that is a fraction of its volume. This minimally invasive injection procedure is applicable in tissue engineering, regenerative medicine, or drug delivery. Also, this hydrogel-based platform allows the administration of soft robots that operate inside the human body.

Features & Benefits

- injectable and retractable
- high compressibility
- biocompatible and biodegradable
- potential carrier for therapeutics
- short preparation time

Publications

- “Perforated red blood cells enable compressible and injectable hydrogels as therapeutic vehicles”, preprint: http://arxiv.org/abs/2308.11264
- Patent pending

transfer

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Technology Readiness Level

1 2 3 **4** 5 6 7 8 9

Background

Functional hydrogels play a role in many medical treatments such as cartilage, bone regeneration, and concentrated drug delivery. Ideally, a minimally invasive operation is sought for inserting hydrogels into the body. A possible route is injection by a cannula, tube or catheter. In this regard problems arise from hydrogels blocking the cannula or being destroyed during injection.

Invention

A functional hydrogel is produced outside the body, which can shrink in volume for transport via cannula, and then regain its original volume when released inside the body, thus, contributing to a minimally invasive injection procedure. The invention describes a method for the preparation of a hydrogel with squeezable, sponge-like structure. The scaffold is built from perforated red blood cells which have been added during the polymerization process. The polymerization occurs around these cells so that they get trapped in the polymer network of the hydrogel.

Red blood cells have a robust cell membrane. They deform under mechanical stress and regain their original shape when released. A chemical process has rendered the cell membrane porous so that liquids can diffuse in and out. When the hydrogel is squeezed, the liquid is drained from the cells, thus, reducing their size and the size of the hydrogel structure. When the stress is lifted - i.e. after passing a cannula - the process reverses and the hydrogel re-inflates.

Several tests were successfully completed in the lab. For example a 10 mm x 10 mm x 0.5 mm hydrogel scaffold passing a 18 G needle (0.96 mm inner diameter).