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A NOVEL BIOACTIVE IMPLANT MATERIAL BASED ON A POROUS SILICONE-HYDROGEL-COMPOSITE

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CONTEXT

Although silicone is denoted to be a biocompatible implant material, its hydrophobicity causes unspecific protein absorption. To avoid this, the silicone material can be modified e.g. with drugs, in order to actively influence the behavior of the surrounding tissue. Blends out of silicone and synthetic hydrogels were shown to be promising drug delivery systems.

But up to now, no silicone-based composites, which can be used to immobilize drug releasing cells, were published.

AIM

The first goal was to generate a composite polymer out of silicone and alginate with an interpenetrating network capable for diffusion of molecules like drugs. The second goal was to create a silicone based material usable as a scaffold for living cells immobilized within the network of the composite.

MATERIAL & METHODS

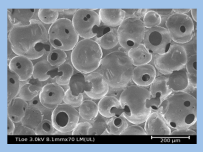

Fig. 1: Scanning electron microscope (SEM) image showing the cross section of a silicone-composite

- Preparation of different mixtures out of PDMS silicone and alginate
- Characterization using Confocal Raman Microscopy and SEM (see Fig. 1)
- Diffusion tests with trypan blue as dummy drug
- Embedding of commercial mesenchymal stem cells (hUC-MSCs) into the pores of the composite with a prior exchange of alginate by Matrigel

SUMMARY

A novel composite material out of silicone and the natural hydrogel alginate was prepared. The composite contains an interpenetrating network.

Good diffusion characteristics for water soluble molecules promote the growth of immobilized mesenchymal stem cells inside the composite.

CONCLUSIONS

The novel silicone-alginate-composite is promising to be usable as a drug delivery system.

The potential use as a scaffold material for drug releasing cells in silicone-based implant materials could be shown.

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RESULTS

Composites out of silicone and alginate build an interpenetrating network at 75% alginate content at least.

The alginate forms crosslinked microchannels within the composite leading to a porous material with pore sizes in the range of 50-300 µm (see Fig. 2).

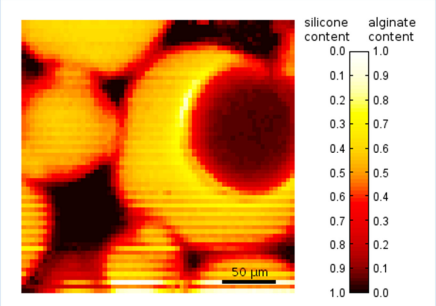

Fig. 2: Confocal Raman Microscopy of the silicone-alginate-composite with interpenetrating network

The diffusion of the dummy drug trypan blue through the composite is only 10% less than the diffusion through the composite with previously flushed alginate (see Fig. 3).

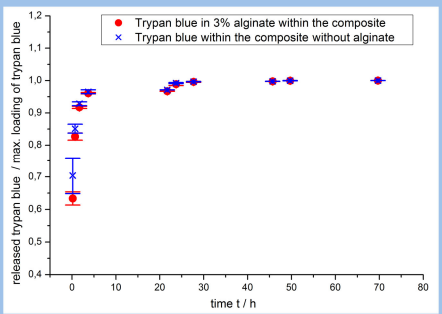

Fig. 3: Diffusion of trypan blue out of a composite and out of a composite with flushed alginate

Mesenchymal stem cells adhere and spread inside the pores of the composite, where the alginate has been flushed before and the material subsequently layered with Matrigel and cells (see Fig. 4).

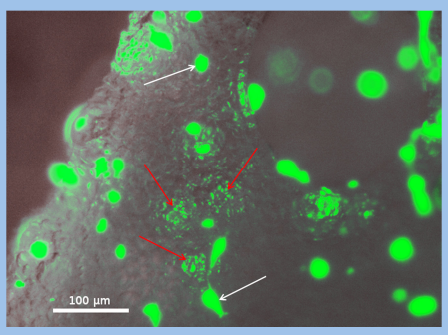

Fig. 4: Growing hUC-MSCs at the surface (white arrows) and inside (red arrows) the composite

First long term evaluations of L929 cells inserted into the alginate of the composite indicate a survival of over 25 days.