



Single step UV-photolithography fabrication of SU-8 honeycombs with microchannels for cells positioning on silicon oxide-based nanopillars

F Larramendy, Marie-Charline Blatché, Pierre Temple-Boyer, O Paul

► To cite this version:

F Larramendy, Marie-Charline Blatché, Pierre Temple-Boyer, O Paul. Single step UV-photolithography fabrication of SU-8 honeycombs with microchannels for cells positioning on silicon oxide-based nanopillars. 13th world congress on biosensors, BIOSENSORS 2014, May 2014, Melbourne, Australia. 2014. hal-01874796

HAL Id: hal-01874796

<https://laas.hal.science/hal-01874796>

Submitted on 25 Sep 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Single-step UV-photolithography Fabrication of SU-8 Honeycombs with Microchannels for Cells Positioning on Silicon Oxide-based Nanopillars

F. Larramendy*, M.C. Blatche**, P. Temple-Boyer** and O. Paul*

*Microsystem Materials Laboratory, Department of Microsystems Engineering (IMTEK), University of Freiburg, Germany
**Laboratory for Analysis and Architecture of Systems (LAAS-CNRS), University of Toulouse, France

Objectives

We report on the **fabrication, functionalization, and testing** of SU-8 microstructures for cell culture and positioning over large areas. The microstructure consists of a **honeycomb** arrangement of **cell containers** interconnected by microchannels and centered around **nanopillar arrays** designed for promoting cell positioning. The structures are fabricated using a **single ultraviolet photolithography exposure** on the SU-8 resist. The proof of concept is given by the successful growth of **interconnected PC12 cells**.

Introduction

Honeycomb structures interconnected by microchannels are fabricated using a **single UV-photolithography** exposure. With optimized process parameters i.e. **focus depth d_f** and **exposure dose D_{exp}** , microchannels of various aspect ratios are produced after photoresist dissolution.

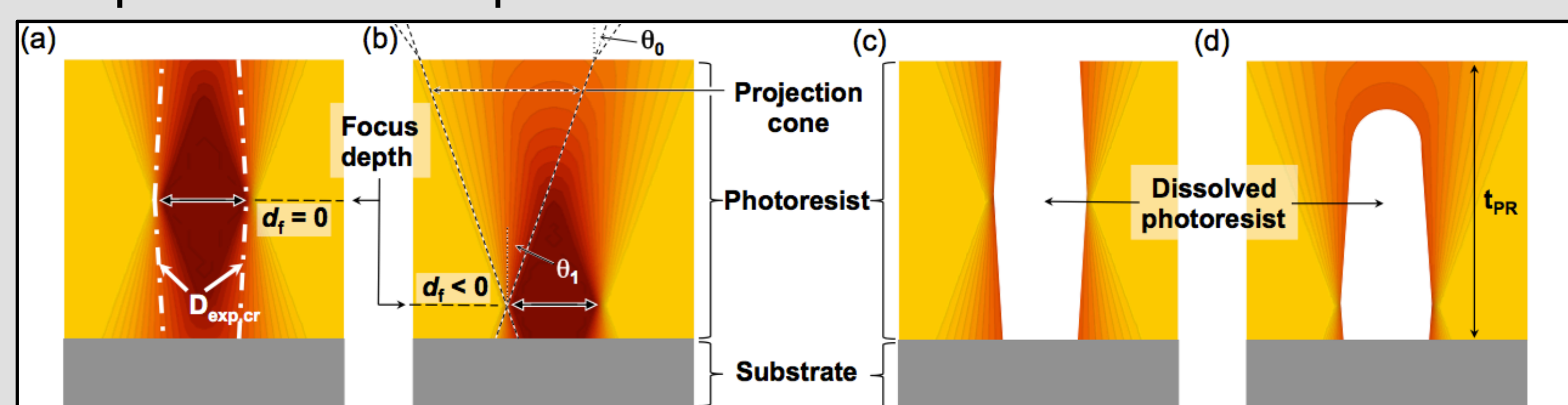


Figure 1: Principle of focus depth d_f variation for producing different types of microchannels in negative photoresist; (a,c) focus in the middle of the photoresist of thickness t_{PR} , (b,d) focus depth shifted downward; darker and clearer shades in photoresist indicate lower and higher exposure doses.

Honeycomb structure characterization

Choosing $d_f < 0$ allows us to focus the reticle in the lower part of the SU-8 film. As a consequence, in Fig. 3(b) pairs of neighboring SU-8 columns are connected in their upper parts by arches and separated in their lower parts by microchannels.

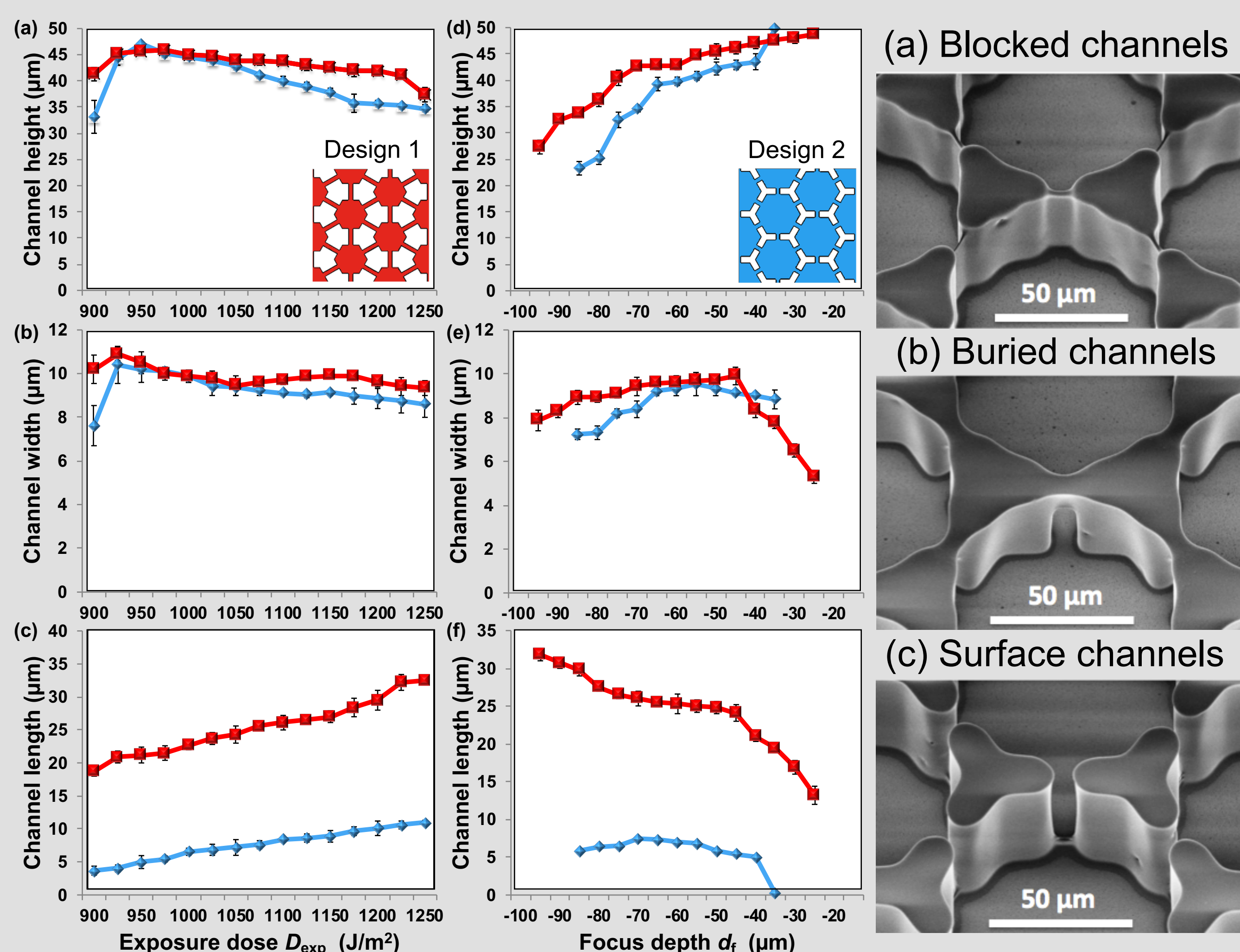


Figure 2: Measured height (a,d), width (b,e) and length (c,f) of microchannels as a function of (a,b,c) D_{exp} for $d_f = -50 \mu m$ and (d,e,f) as a function of d_f for $D_{exp} = 1100 J/m^2$ for Designs 1 (red symbols) and 2 (blue symbols) with $t_{PR} = 50 \mu m$.

Figure 3: SEM of cell container honeycombs of Design 2 obtained with 3 different values of d_f ($d_{f(a)} < d_{f(b)} < d_{f(c)}$).

Cell pre-positioning on nanopillars by interconnected cell containers

Design 1 and 2 cell container structures were realized around 3 sizes (types A-C) of nanopillar arrays to study the influence of nanopillars on cell growth. PC12 cells were cultured on chips with nanopillars and SU-8 cell containers for 5 days.

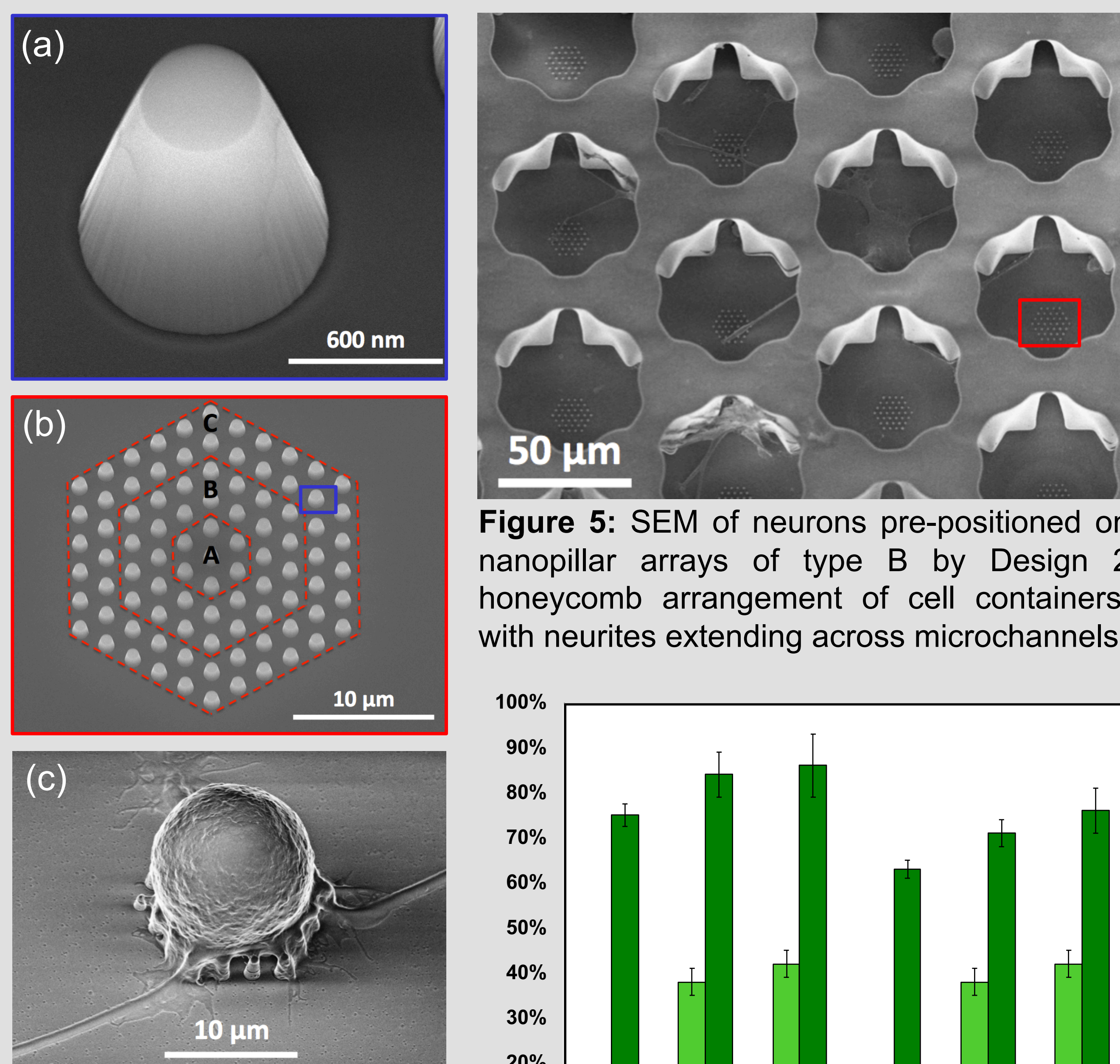


Figure 4: SEM of (a) a nanopillar and (b) a hexagonal array of 91 nanopillars termed type C. Smaller arrays have 37 (type B) and 7 (type A) nanopillars, as outlined in (b). (c) A neuron on a nanopillar array of type B with neurite growth.

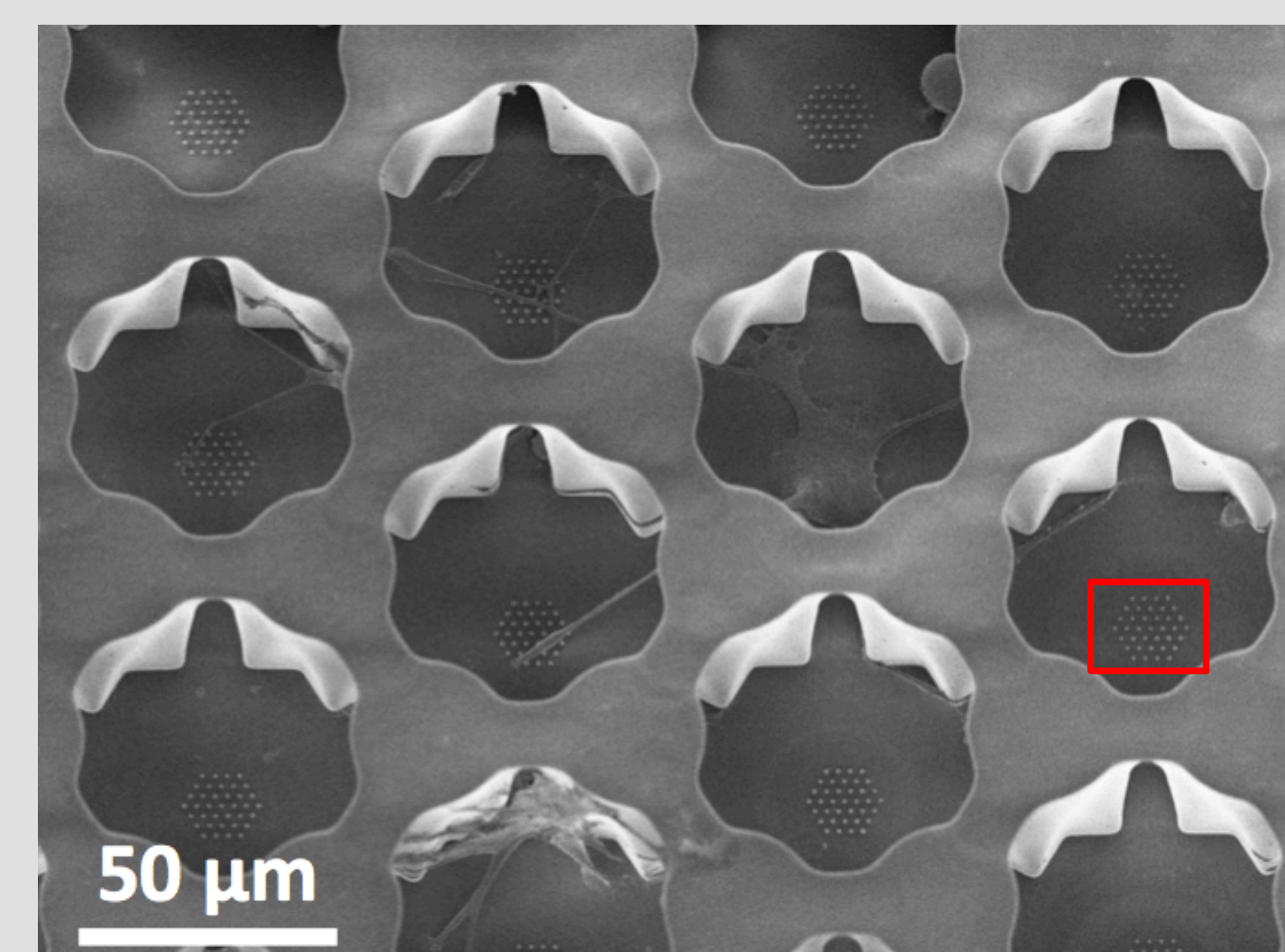


Figure 5: SEM of neurons pre-positioned on nanopillar arrays of type B by Design 2 honeycomb arrangement of cell containers, with neurites extending across microchannels

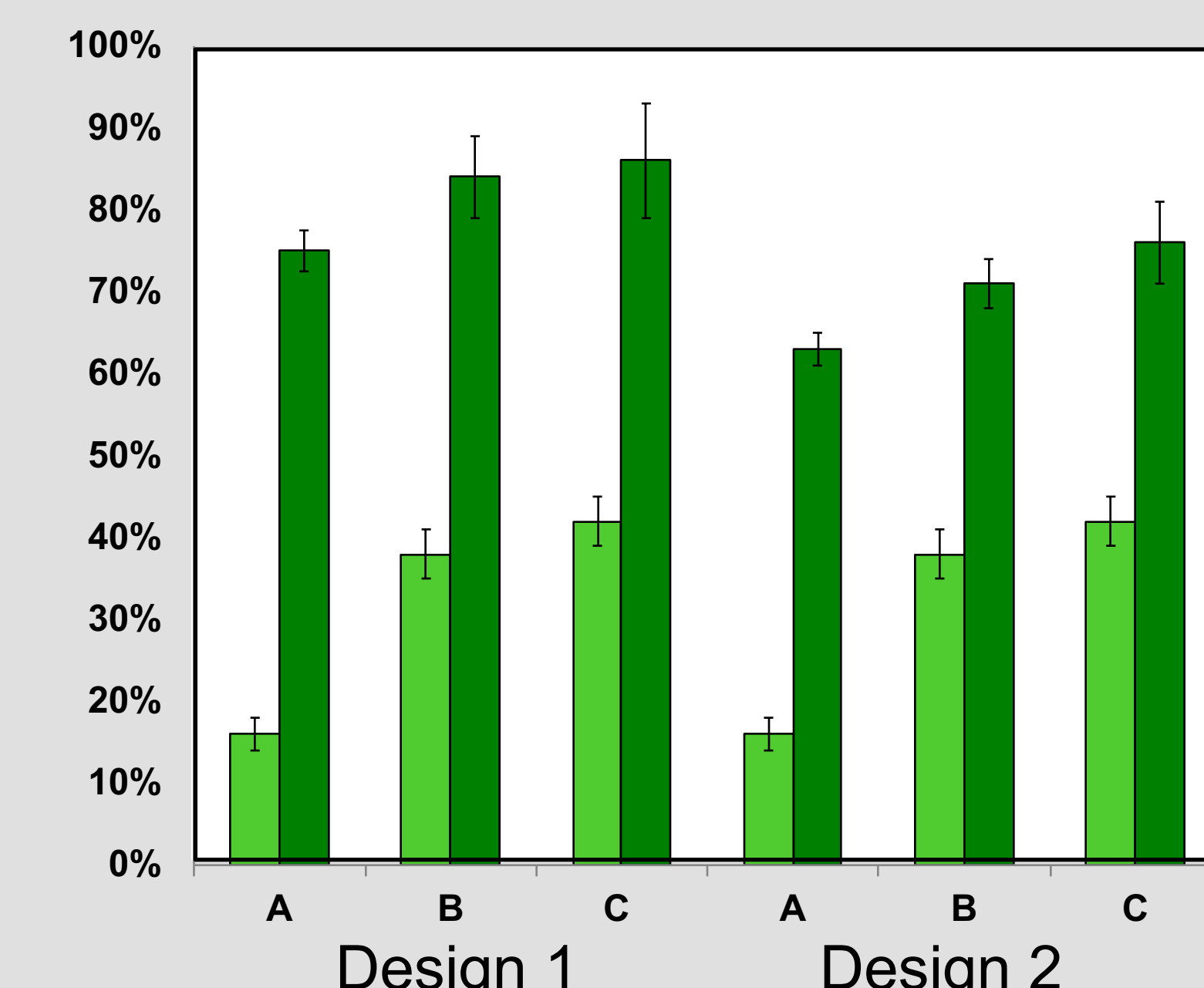


Figure 6: Percentages of cells connected to nanopillar arrays of types A to C on silicon substrates without SU-8 structures (darker green bars) and embedded in interconnected honeycomb structures of Designs 1 and 2 (lighter green bar).

Conclusions

UV stepper projection lithography was used in a non-standard way to fabricate SU-8 based cell containers arranged in a honeycomb structure and connected by microchannels around nanopillars. Thanks to cell culture, we have proven that the interconnect SU-8 cell containers significantly increase the fraction of cells connected to nanopillars.

Acknowledgements

Technical support by L. Mazenq, A. Laborde and A. Lecestre at LAAS-CNRS (France) and by Prof. S. Takeuchi (IIS, the University of Tokyo, Japan) and his team and financial support by project EUJO-LIMMS (no. 295089) funded by the EU 7th Framework Programme are gratefully acknowledged.

Contact & Download

Florian.larramendy@imtek.uni-freiburg.de
temple@laas.fr, paul@imtek.de

