

Forschungsschwerpunkt Regeneration, Implantate, Medizintechnik der TU Hamburg-Harburg

Sprecher

**Prof. Dr. Michael Morlock Ph.D.
Leiter Institut für Biomechanik**

**Prof. Dr.-Ing. Ralf Pörtner
Institut für Bioprozess- und Biosystemtechnik**

THE NEW ERA OF REGENERATIVE MEDICINE
Dozens of biotech companies and university labs are developing ways to replace or regenerate failed body parts. Here are a few of the projects.

BONE
Bone-growth factors or stem cells are inserted into a porous material cut to specific shape, creating new jaws or limbs. A product that creates shinbones is in clinical trials.
COMPANIES: Organogenesis, Biomolecules, Orquest.

SKIN
Organogenesis' Apligraf, a human-skin equivalent, is used to treat leg ulcers. Other skins are in the pipeline.
COMPANIES: Organogenesis, Advanced Tissue Sciences, Integra LifeSciences, LifeCell, Cytoc International.

HEART VALVES, ARTERIES, AND VEINS
A 10-year initiative to build a heart has just started. Genetically engineered proteins have been successfully used to regrow blood vessels.
COMPANIES: Organogenesis, Advanced Tissue Sciences, Genetech, LifeCell, Rejuvenation.

SALIVA GLANDS
Proteins called aquaporins that allow cells to secrete water are used to recreate saliva glands damaged by disease or radiation. Glands are also being engineered to secrete healing drugs. The technique has proven successful in mice.
COMPANIES: None yet.

URINARY TRACT
Cartilage cells are grown from a patient's own body tissue, and injected into the weakened ureter, where they bulk up the tissue.
COMPANIES: Rejuvenation, Integra LifeSciences.

BLADDER
Scientists at Children's Hospital in Philadelphia have grown bladders from skin cells and implanted them in sheep. They are about to try the same process on a patient.
COMPANIES: Rejuvenation.

CARTILAGE
A product is already on the market that regrows knee cartilage. A chest has been grown for a boy and a human ear on a mouse.
COMPANIES: Genzyme Tissue, Biomatrix, Integra LifeSciences, Advanced Tissue Sciences, ReGen Biologics, Osiris Therapeutics.

TEETH
Enamel matrix proteins are used to fill cavities. It works in dogs; human trials are a few years away.
COMPANIES: Biora, Atrix Laboratories, Creative BioMolecules.

BREAST
In preclinical studies, several companies have been able to create a cosmetic breast.
COMPANIES: Rejuvenation, Integra LifeSciences.

LIVER
A spongy membrane is built on a scaffold, then a patient's liver cells are added. Livers the size of a dime have been grown, but a full-size liver could take 10 years due to its complexity.
COMPANIES: Advanced Tissue Sciences, Human Organ Sciences, Organogenesis.

SPINAL CORD NERVES
Scientists are investigating nerve-growth factors, injecting them at the site of damage to encourage regeneration or seeding them along biodegradable filaments and implanting them. Rats have been made to walk again.
COMPANIES: Acorda, Rejuvenation, CytoTherapeutics, Guilford Pharmaceuticals.

SATA BUSINESS WEEK, DRUG & MARKET DEVELOPMENT REPORTS

... eines Tages wird es Routine sein, Patienten mit Organen oder Geweben aus dem Bioreaktor zu versorgen, so wie heute ein Coronarer Bypass operiert wird ...

Regeneration

TUHH : Pörtner, Schilling
Morlock

UKE : Adamietz, Meenen,
Amling, Püschel

Implantate Biomechanik

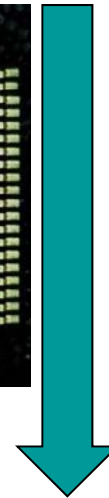
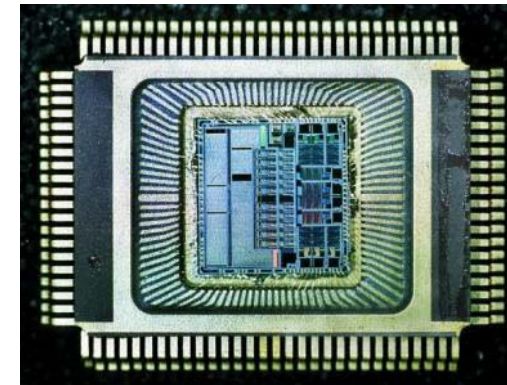
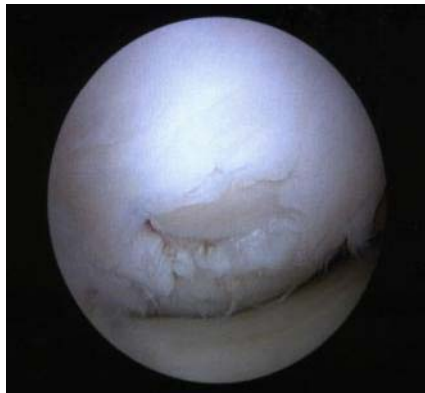
TUHH : Morlock,
Emmelmann

UKE : Amling, Rüger,
Schmelzle, Püschel

Medizintechnik

TUHH : Müller, Grigat,
Krauschneider

UKE : Adam, Eschenhagen



FSP Regeneration, Implantate, Medizintechnik

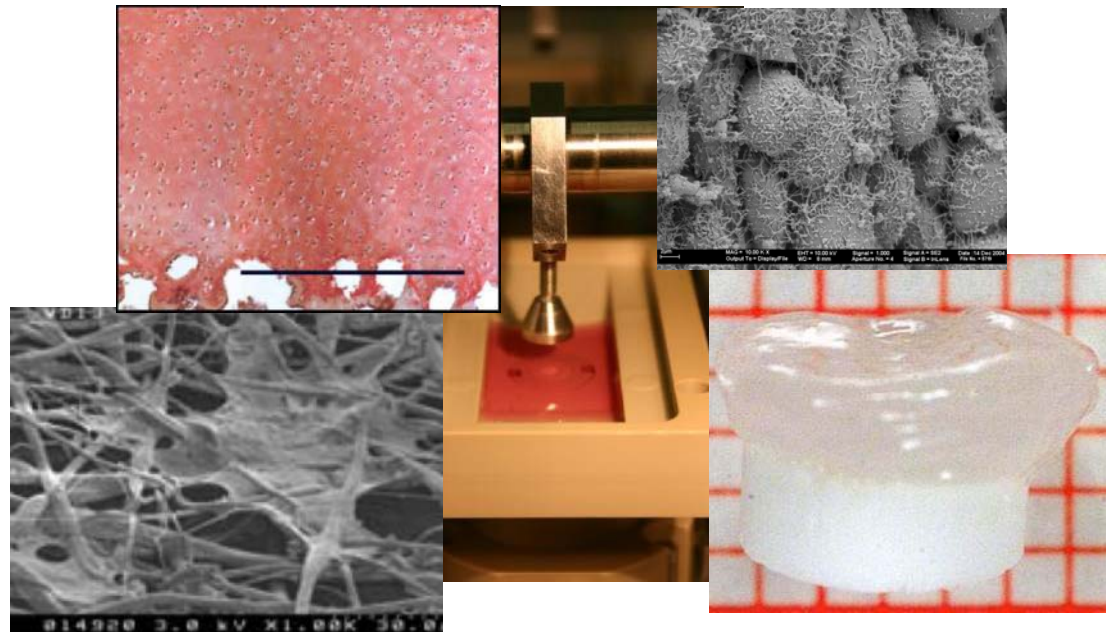
Emmelmann	(Laser- und Anlagensystemtechnik)	Mackens	(numerische Simulation)
Herweg	(Thermofluidynamik)	Morlock	(Biomechanik)
Hoffmann	(Mechanik und Meerestechnik)	Pörtner	(Bioprocess- und Biosystemtechnik)
Janssen	(keramische Hochleistungswerkst.)	Schilling	(Biomechanik)
Johannsen	(thermische Verfahrenstechnik)	Schneider	(keramische Hochleistungswerkstoffe)
Krautschneider	(Nanoelektronik)	Schulte	(Kunststoffe und Verbundwerkstoffe)
Lukacova	(Numerische Simulation)	Smirnova	(Thermische Verfahrenstechnik)
Matz	(Messtechnik)	Zeng	(Bioprocess- und Biosystemtechnik)

Fördermittel 08/09: 4.2 Mio €

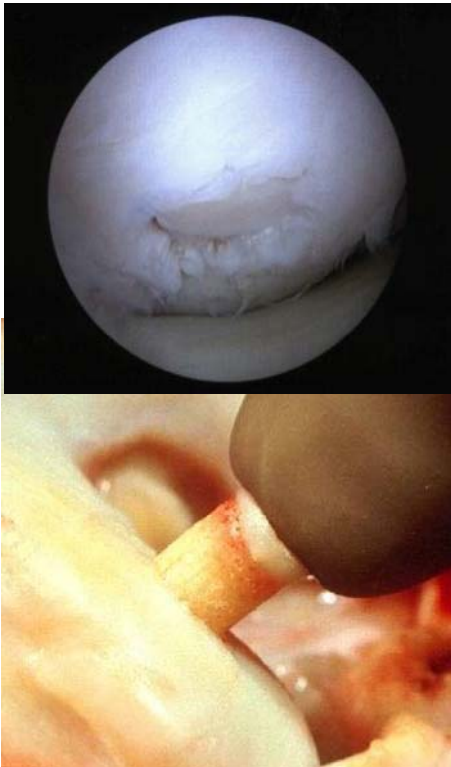
externe Partner

UKE, GKSS

Industriekooperationen



Projektbeispiele

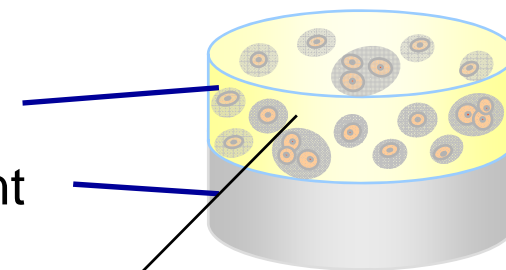


Meenen *et al.* 2003

Autologe osteochondrale Transplantation (AOT)

- Nachteil: große Entnahmedefekte
- Konzept zur Vermeidung der Nachteile:

- Knorpelschicht
- Knochenäquivalent



biohybrides Implantat

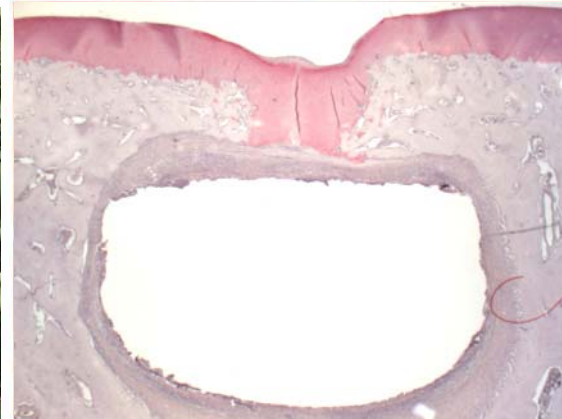
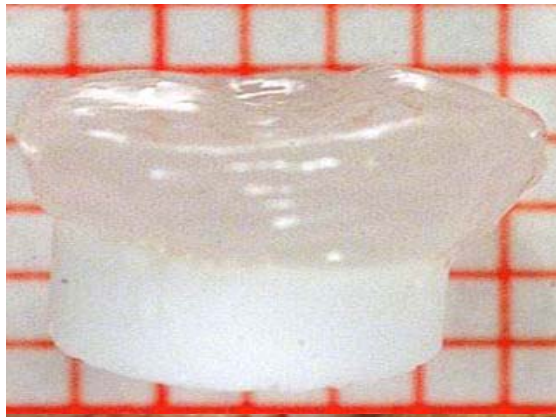
Lässt sich ein solches biohybrides Implantat in einem speziellen Bioreaktor züchten?

* **PD Dr. P. Adamietz**, UKE, Institut für Biochemie und Molekularbiologie II, Prof. Dr. Dr. U. Beisiegel

* **Prof. Dr. N.M. Meenen**, UKE, Klinik und Poliklinik für Unfall-, Hand- und Wiederherstellungschirurgie, Klinikdirektor: Prof. Dr. med. Johannes M. Rueger, (jetzt Altonaer Kinder-Krankenhaus)

BMBF-Projekt: Entwicklung eines biohybriden Gelenkflächenersatzes (1999-2002)

- Prof. Dr. N. M. Meenen, PD DR. P. Adamietz, UKE, Hamburg
- PD Dr.-Ing. Ralf Pörtner, TUHH
- Prof. Dr. H. Kessler, TU München
- Biomet Deutschland GmbH, Darmstadt

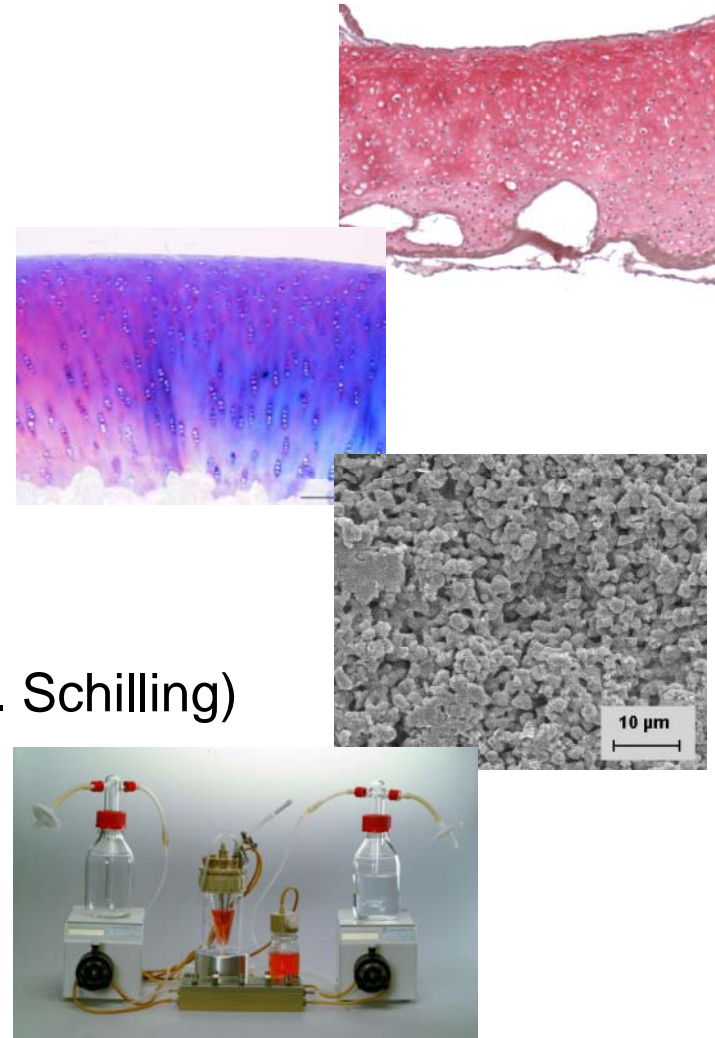


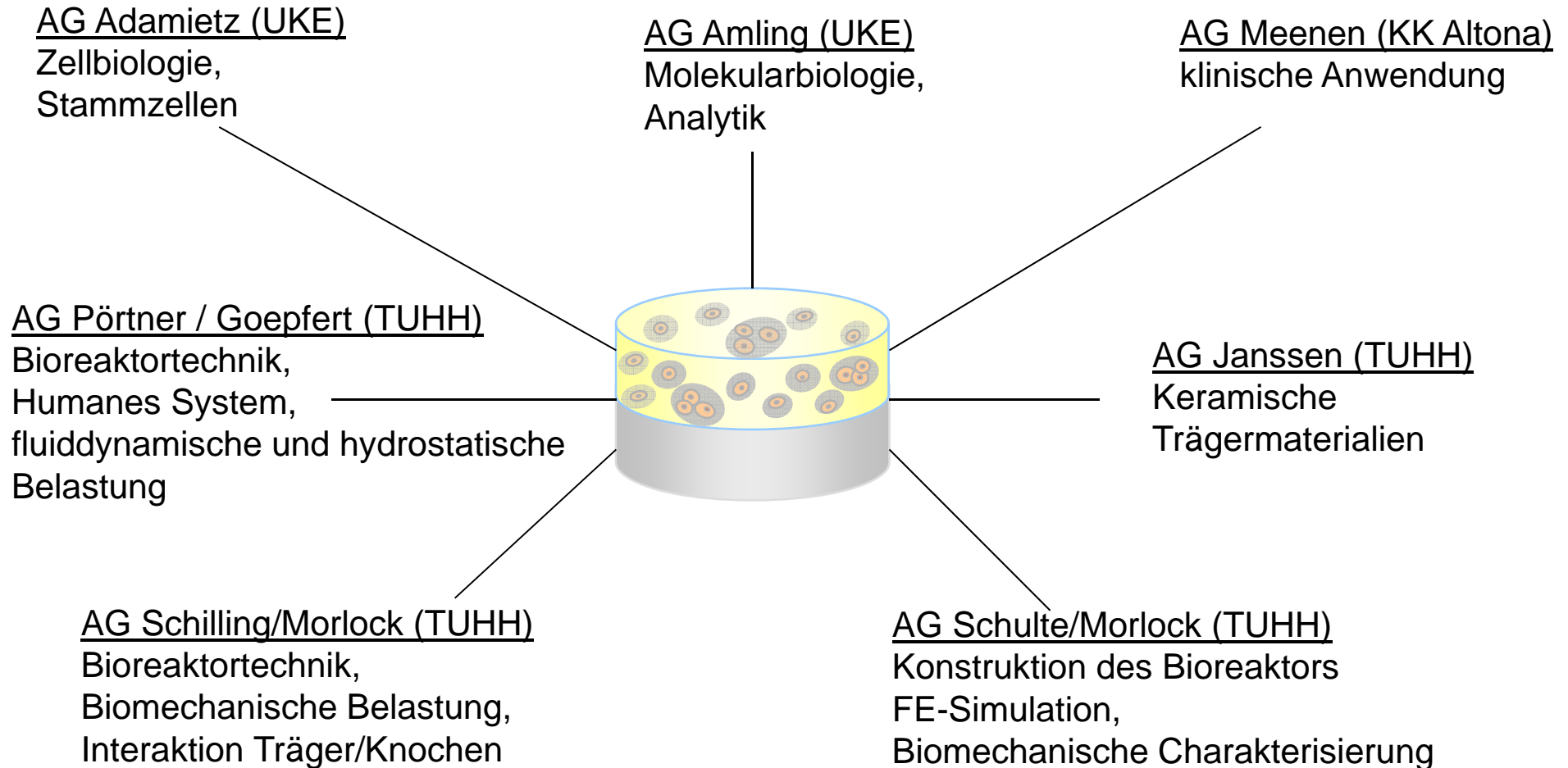
„Qualitätsoffensive Tissue Engineering“

gefördert durch BWF Hamburg
2003 – 2005

Junior-Professur „Gewebe-materialien“
im Institut für Biomechanik der TUHH
(Prof. Dr. E. Eisenbarth, seit 2007 Prof. Dr. A. Schilling)

gefördert durch Bode-Stiftung





gefördert durch

BMBF 1999-2002

BWF Hamburg, 2003-2005 (Qualitätsoffensive „Tissue Engineering“)

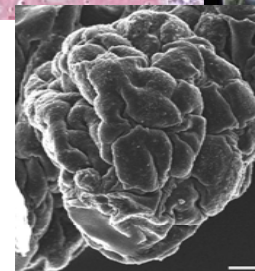
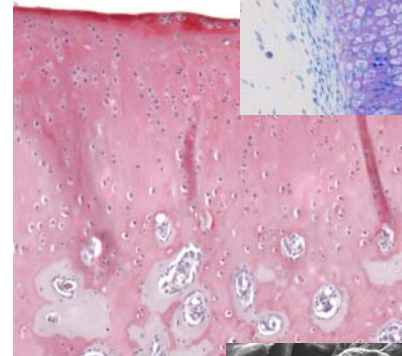
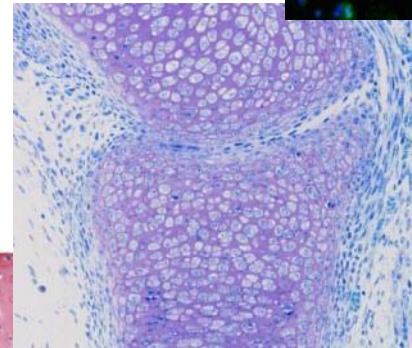
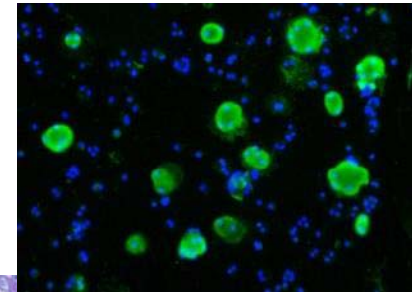
DFG seit April 2006

Universitäre Partner

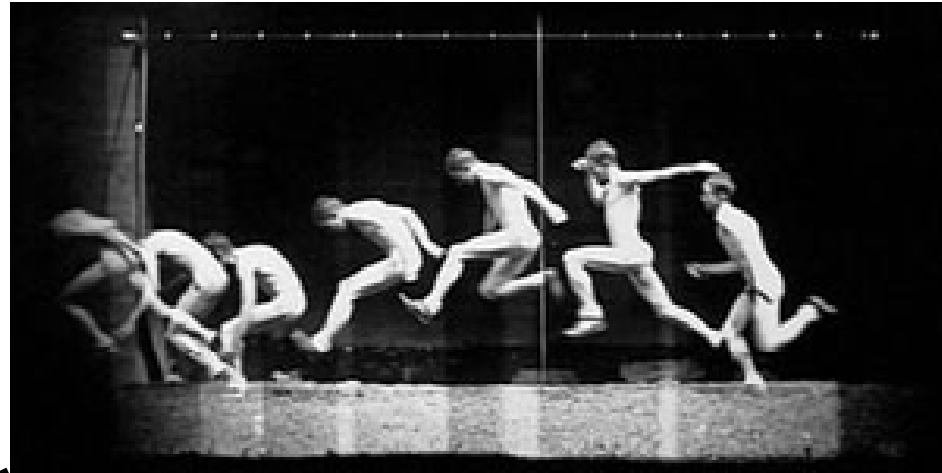
- Prof. Püschel, UKE Hamburg
- Prof. Schumacher, UKE Hamburg
- Prof. Scheper, PD Dr. Kasper, Universität Hannover
- Prof. Becker, Universität Stuttgart-Hohenheim
- Dr. Willumeit, Dr. Feyerabend, GKSS
- Prof. Janet Ronsky, University of Calgary

Firmen

- Zellwerk GmbH, Eichstätt
- Medorex eK, Bovenden
- Bioglobe GmbH, Hamburg
- Aesculap GmbH, Tuttlingen
- Kayser-Threde GmbH, München
- Innovacell, Innsbruck
- Zimmer, Winterthur



Tissue Engineering von Knorpel-Träger-Konstrukten unter Mechano-Stimulation



hydrostatische
Belastung (Druck),
patentiert, AG Pörtner



fluiddynamische Belastung
(überströmende Flüssigkeit),
patentiert, AG Pörtner

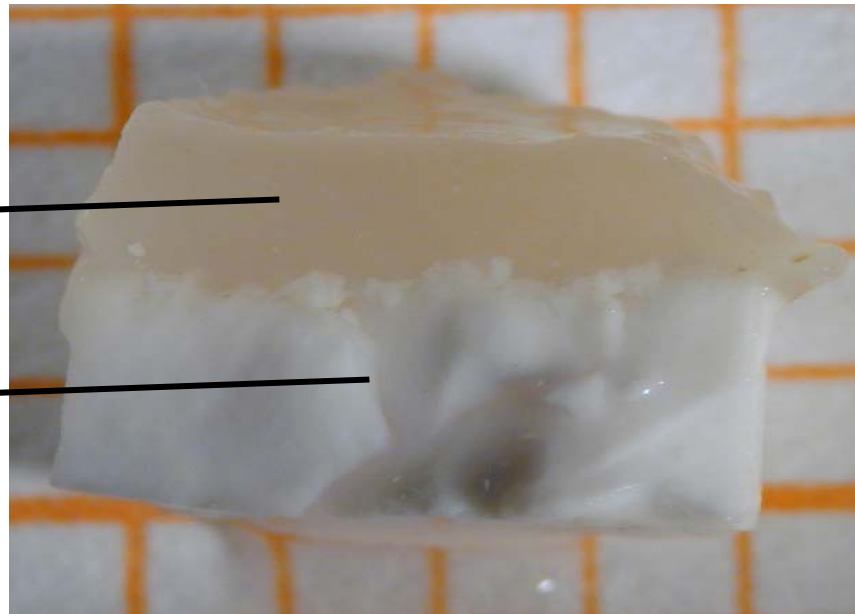


mechanische Belastung
(Normalkräfte, Rollen,
Gleiten, Scherung), AG
Schilling/Morlock

Systematische Analyse, Charakterisierung und Steuerung der Knorpelbildung „in vitro“

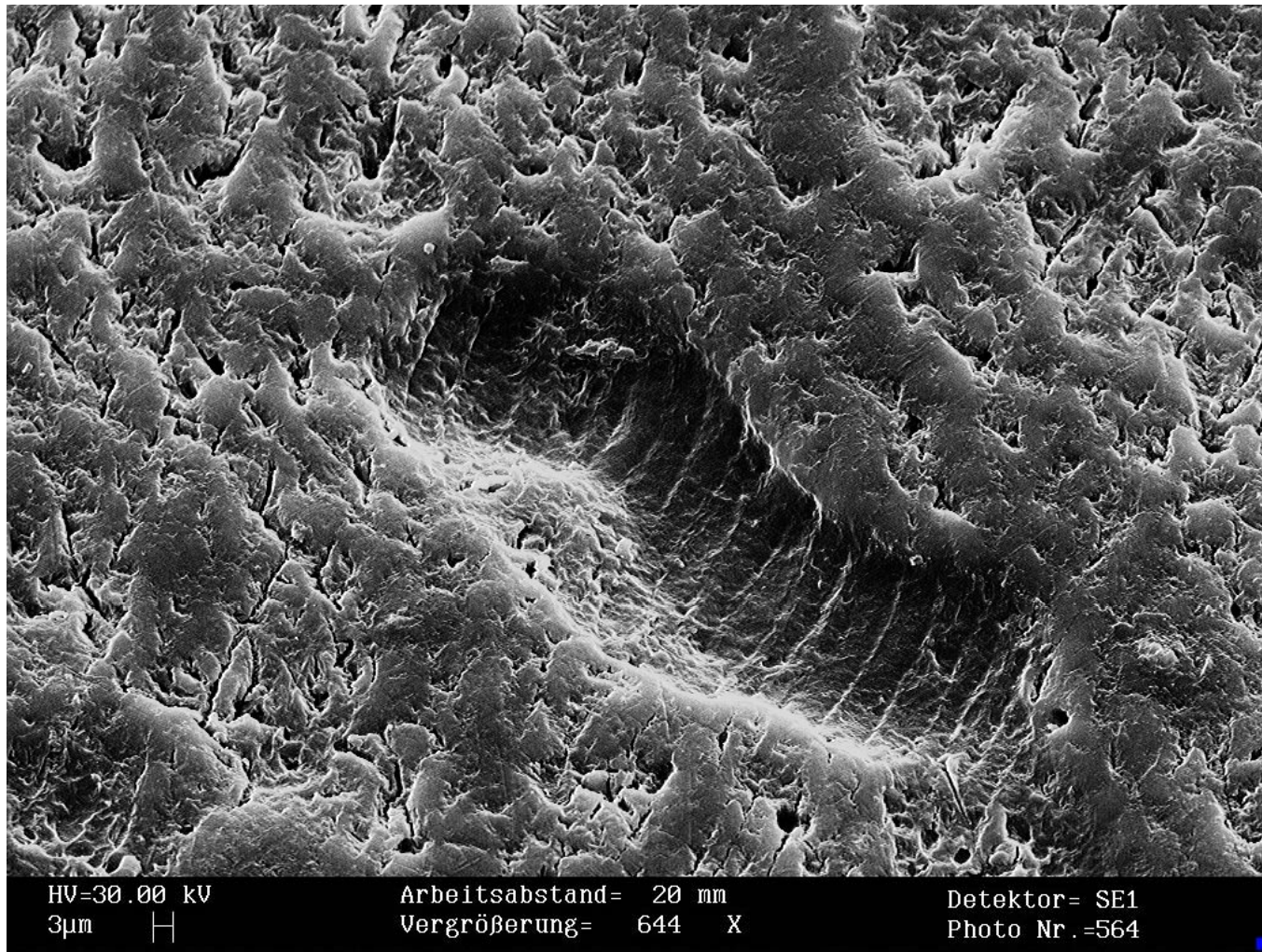
Knorpel

keramischer
Träger



- Erweiterung des Systemverständnisses zur Knorpelbildung „in vitro“ durch
 - Erweiterte **molekularbiologische Analytik** (Transkriptom, Proteom, Metabolom)
 - Systembiologische Ansätze zur Aufklärung des regulatorischen Netzwerkes bei der Knorpelbildung (in Anlehnung an BMBF-Projekt SysLogics für Produktionszellen, Prof. Zeng, Prof. Pörtner)
 - Simulation der **mechanischen Belastung** / Lastverteilung innerhalb des Knorpels / Knochens (FE-Simulation)
 - Neue **Bioreaktorkonzepte** als Tools zur Beantwortung spezifischer Fragestellungen mit **integrierter Sensorik (Mikrosystemtechnik)**
 - **Interaktion Zelle / Biomaterial** (Juniorprofessur Schilling)
 - Neue **bildgebende Verfahren** zur Strukturanalyse

Resorbierbarkeit von Knochenersatzmaterial (Prof. Schilling, Biomechanik)



Projektbeispiele (in Bearbeitung)

Projektbeispiele (in Bearbeitung)