FEDERAL INSTITUTE
FOR RISK ASSESSMENT

Freie Universität Berlin

BfR
Bundesinstitut für Risikobewertung

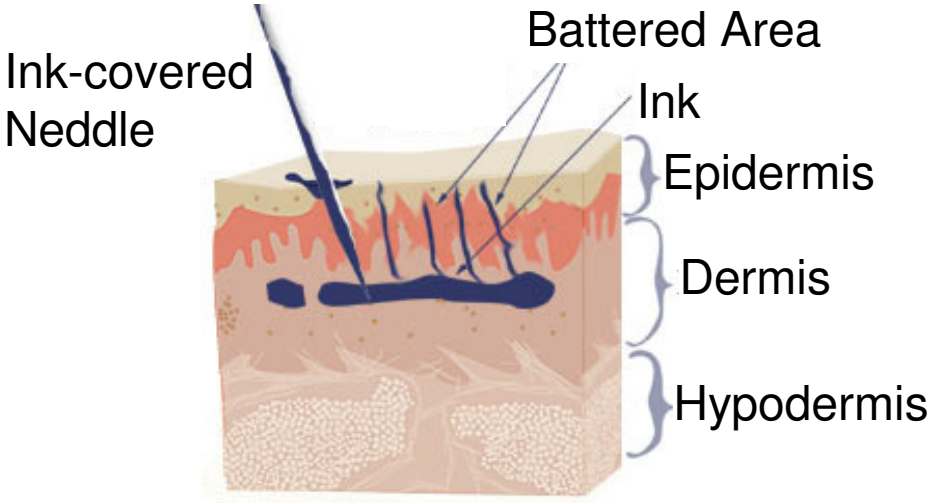
Session IV Technology

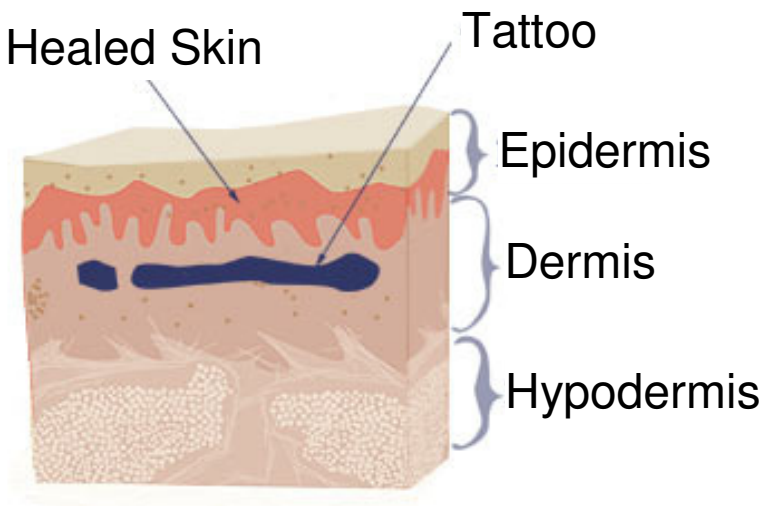
Peter Laux

BfR-Symposium: „First International Conference on Tattoo Safety“

June 7, 2013

Localization of Tattoo Inks





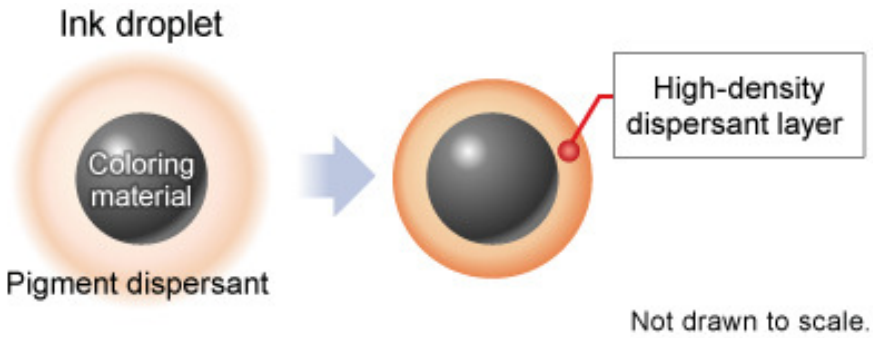
http://www.cockeyed.com/science/tattoo/tattoo.html

Tattoo Ink = Subcutanous Implant

Soluble Ingredients	**Predominantly Insoluble Pigments**
Preservatives: Benzoic Acid Contaminants: Aromatic Amines	Inorganic: FeO Organic: Diketopyrrolopyrrol
100% Systemic Available and Metabolized	**Systemic Distribution?** **Breakdown?** **Nanosized Particles?**

Encapsulation in Biocompatible Materials?

Encapsulation: Inkjet Printing



http://media.canon-asia.com/v3.5media/products/inkjet_printer/pro1/luciatechnologyguide/p02.html

Silk Fabrics: Polyacrylate Encapsulation Enhances Light Fastness

Colour	Pigment Color Index	Color change (ΔEab*)	
		Surface modified Pigment Ink	Encapsulated Pigment Ink
Cyan	C.I. Pigment Blue 15:4	6.8	4.5
Magenta	C.I. Pigment Red 122	5.6	4.4
Black	C.I. Pigment Black 7	2.2	2.0

S Leelajariyakul, H Noguchi, S Kiatkamjornwong, Surface-modified and micro-encapsulated pigmented inks for ink jet printing on textile fabrics, Progress in Organic Coatings, 62 (2), 2008, 145–161

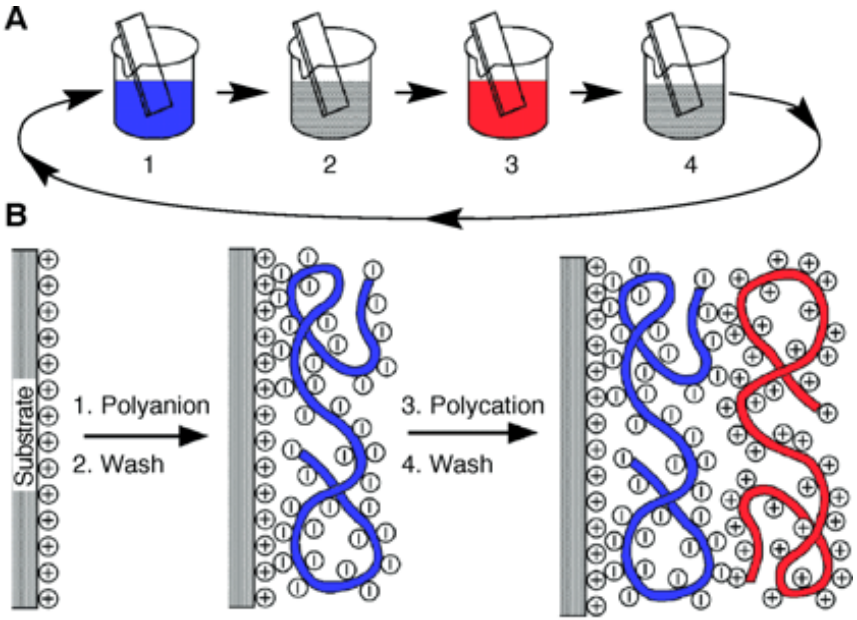
Microencapsulation of Dyes and Pigments

PD Dr. Lars Dähne

- Founder and CEO of Surflay GmbH, Berlin
- PhD in Chemistry of Organic Colourants
- Habilitation at the Institute for Physical Chemistry, FU Berlin
- In 2001 he co-founded the company Capsulution

Generation of Polyelectrolyte Multilayers

A) Adsorption of Polyanion, Polycation



B) Simplified Molecular Picture

G Decher, Fuzzy Nanoassemblies: Toward Layered Polymeric Multicomposites, Science 1997, 277, 1232-1237

Applications:

- Macromolecules and Crystals e.g. Semiconductors
- Biomolecules
- .....

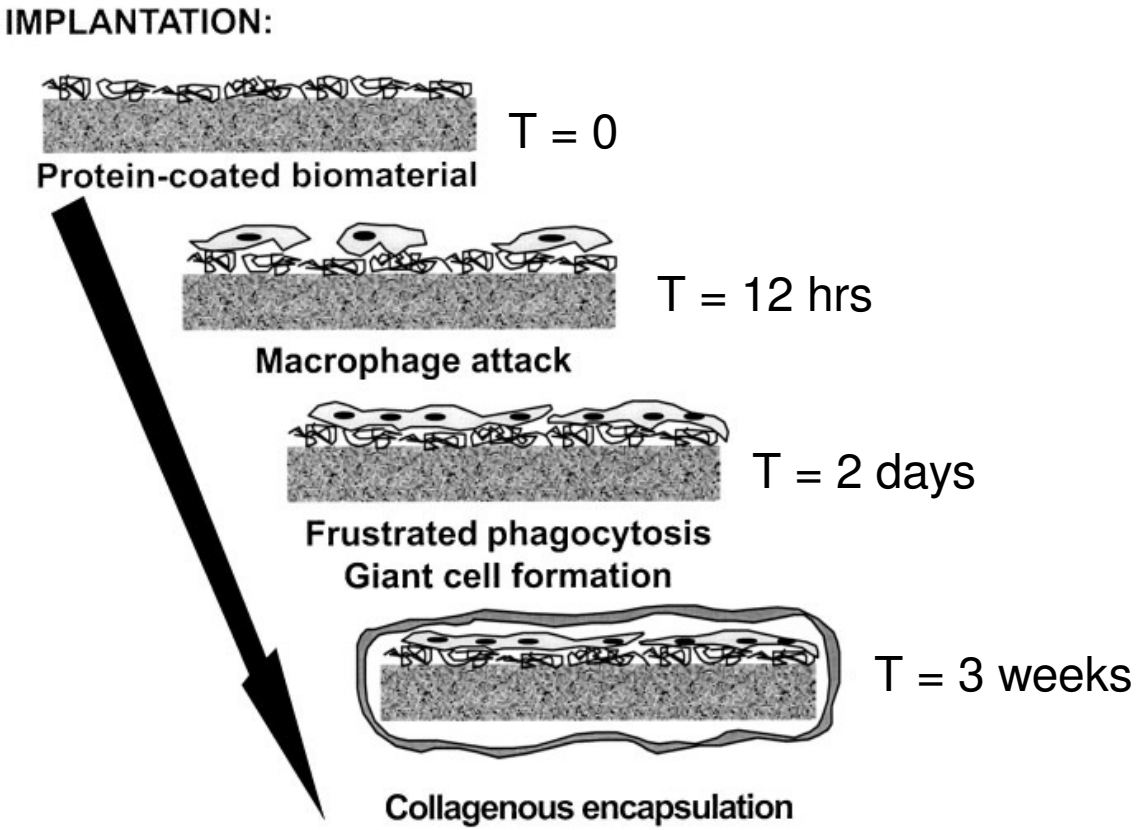
CS Peyratout, L Dähne, Tailor-Made Polyelectrolyte Microcapsules: From Multilayers to Smart Containers, Angew. Chem. Int. Ed. 2004, 43, 3762-3783

Development of Permanent but Removable Tattoos

Bruce Klitzman, Ph.D.

- Associate Research Professor, Dept. Biomedical Engineering
- Senior Director, Kenan Plastic Surgery Research Laboratories at Duke University Medical Center, Durham, NC, USA
- Founder of the North Carolina Tissue Engineering and Regenerative Medicine Society (NCTERMS) in 1998

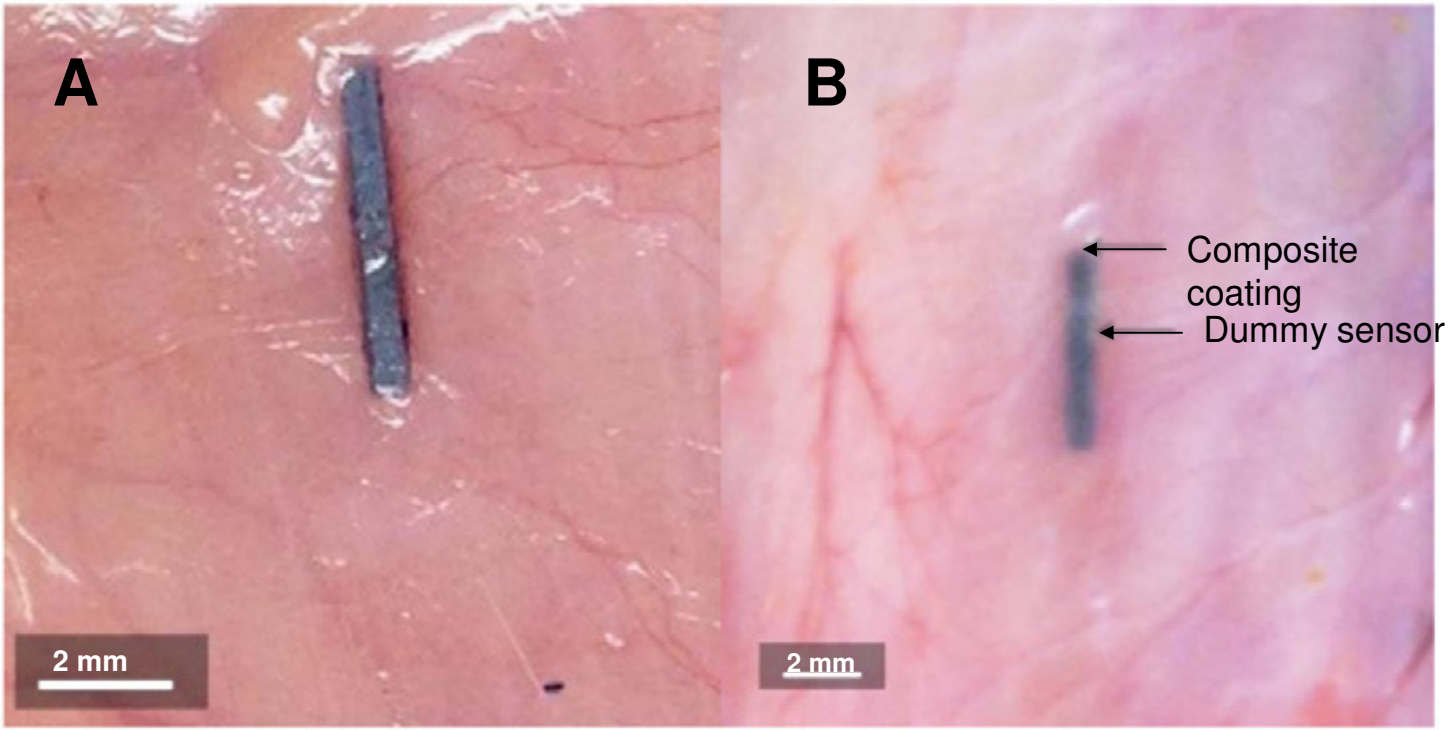
Developing Materials that Mitigate Foreign Body Response (FBR) to Implants



http://ars.els-cdn.com/content/image/1-s2.0-S0168365901005028-gr1.jpg

- Major complication for functionality of glucose sensors
- Sequestration of implant from surrounding surface
- Encapsulation is blocking diffusion, inhibiting accurate measurements e.g. of glucose

Developing Materials that Mitigate Foreign Body Response (FBR) to Implants



Subcutaneous tissue containing dummy sensor without composite coating (A) and composite coated dummy sensor (B).

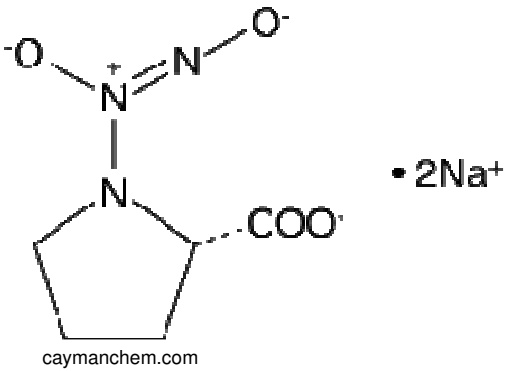
Y Wang, F Papadimitrakopoulos, D J Burgess; Polymeric "smart" coatings to prevent foreign body response to implantable biosensors; Journal of Controlled Release; 5 January 2013

- **Stainless steel wires were coated with particle doped polyurethanes**
- **Different capabilities of releasing Nitric Oxide**

1) Nitrogen Oxide Releasing Systems

PROLI/NO
1-[2-(carboxylato) pyrrolidin-1-yl] diazen-1-ium-1, 2-diolate

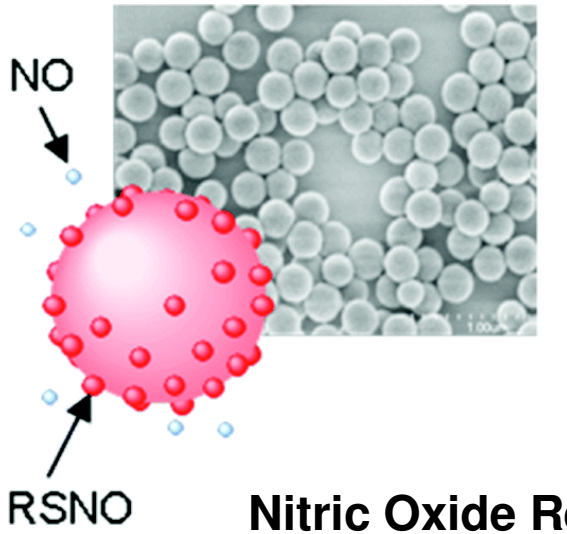
JE Saavedra, GJ Southan, KM Davies, A Lundell, C Markou, SR Hanson, C Adrie, WE Hurford, WM Zapol, L Keefer, Localizing Antithrombotic and Vasodilatory Activity with a Novel, Ultrafast Nitric Oxide Donor1996, J. Med. Chem., 39, 4361–4365



2 Seconds Half Life Time

Nitric Oxide Releasing Silica Nanoparticles

DA Riccio, JL Nugent, MH Schoenfisch, Stöber Synthesis of Nitric Oxide-Releasing *S*-Nitrosothiol-Modified Silica Particles, Chem. Mater., 2011, 23 (7), 1727–1735



Nitric Oxide Release > 48 h

2) Polyurethane Topcoat 40 mg/ml dissolved in THF

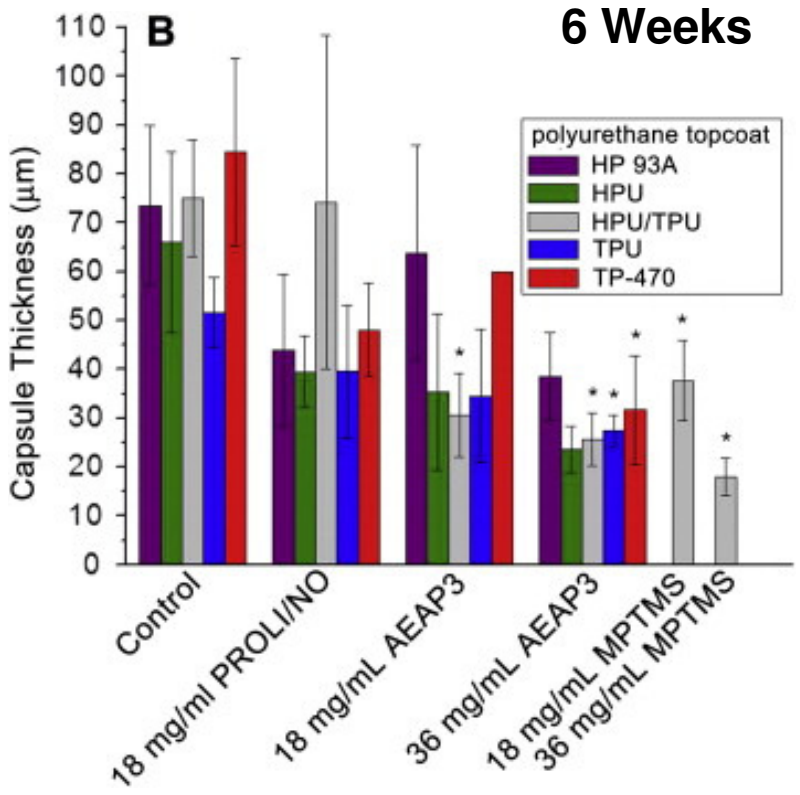
HP 93 A	**HPU**	**HP/TPU**	**TPU**	**TP-470**

⟶ Implantation into Piglets: Histological Analysis after 3, 7, 21 or 42 days

Collagen Capsule Surrounding Polyurethane-coated Wire Substrates

Important for Reduction of Capsule Thickness:

- **Long release of Nitric Oxide**
- **Large Initial Payload with Nitric Oxide**
- **Enhancing Hydrophobicity of Polymer Matrix**
- **Studies on Percuteanous Implants**



Significant differences between NO-releasing and relative controls are indicated at $p < 0.05$ (*)

SP Nichols, A Koh, NL Brown, MB Rose, B Sun, DL Slomberg, DA Riccio, B Klitzman, MH Schoenfisch, The effect of nitric oxide surface flux on the foreign body response to subcutaneous implants, Biomaterials, 2012, 33(27), 6305-12

Modern Laser Tattoo Removal

and Emerging Technologies to Enhance Efficacy

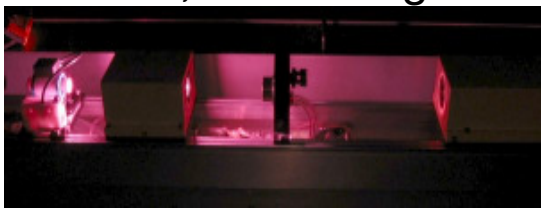
Eric F. Bernstein, M.D., Ph.D.

- Yale University School of Medicine
- Main Line Center for Laser Surgery, Ardmore, PA, USA
- Clinical Professor, University of Pennsylvania
- One of the World's Leading Experts on Laser Medicine and Surgery

Tattoo Removal using Q-switched Lasers

Ruby Laser

- Wavelength 694 nm
- First laser for tattoos
- Black, blue and green



http://technology.niagarac.on.ca/courses/phtn1500/Lab-RubyLaserExpt.html

Alexandrite Laser

- Wavelength of 755 nm
- Green, blue and black

http://www.alibaba.com/product-gs/706497410/Alexandrite_laser_ tattoo_removal_machine_with.html

Nd:YAG Laser

(**N**eo**d**ymium:**Y**ttrium-**A**luminum-**G**arnet)

- Wavelength of 1064 nm
- Black and dark blue
- By a potassium titanyl phosphate crystal doubling of frequency: 532 nm
- Red, orange and some yellow

http://newyorknatives.com/park-avenue-punk-part-iii-scars/#.UayNNazjGfk

EF Bernstein, Laser Tattoo Removal, Semin Plast Surg. 2007, 21(3), 175–192

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Thanks for Your Attention!

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