

Smart System for Light Treatment of Chronic Wounds

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Outline

1. The MEDILIGHT Project

Project partners

2. Health Facts

Wound types, number of cases, costs, remedial measure

3. The MEDILIGHT SYSTEM

a. Illumination System + URGO Wound Dressing

Flexible, high power/efficiency, homogenous illumination

b. Electronics & Software

Light controlling and timing, measurement of oxygenation and temperature

4. In-Vitro Testing

Different healing stages, inhibition of bacteria growth, prevention of overshooting epidermisation, final promotion of skin cell growth



Project Facts

- Duration: 02/15 – 01/18
- Project Costs: 3 Mio €
- Co-funded by the European Union as a H2020 Research & Innovation Action
- www.medilight-project.eu



The project MEDILIGHT receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 644267.

Health Facts...

- Chronic (non-healing) wounds:
 - Diabetic foot ulcers
 - Pressure ulcers
 - Leg ulcers (venous stasis ulcers)
- Significant reduction of quality of life
- Infections, amputations and even death
- Increasing with aging of the population
- 170 Mio. people worldwide affected
- Costs are 40 billion € per year
- Difficult to treat
- Therapeutic effect of visible light has been proven
- Blue light:
 - antibacterial effects at the skin surface



Diabetic Foot Ulcer



Pressure Ulcer



Venous Leg Ulcer

The MEDILIGHT System

1. Illumination System

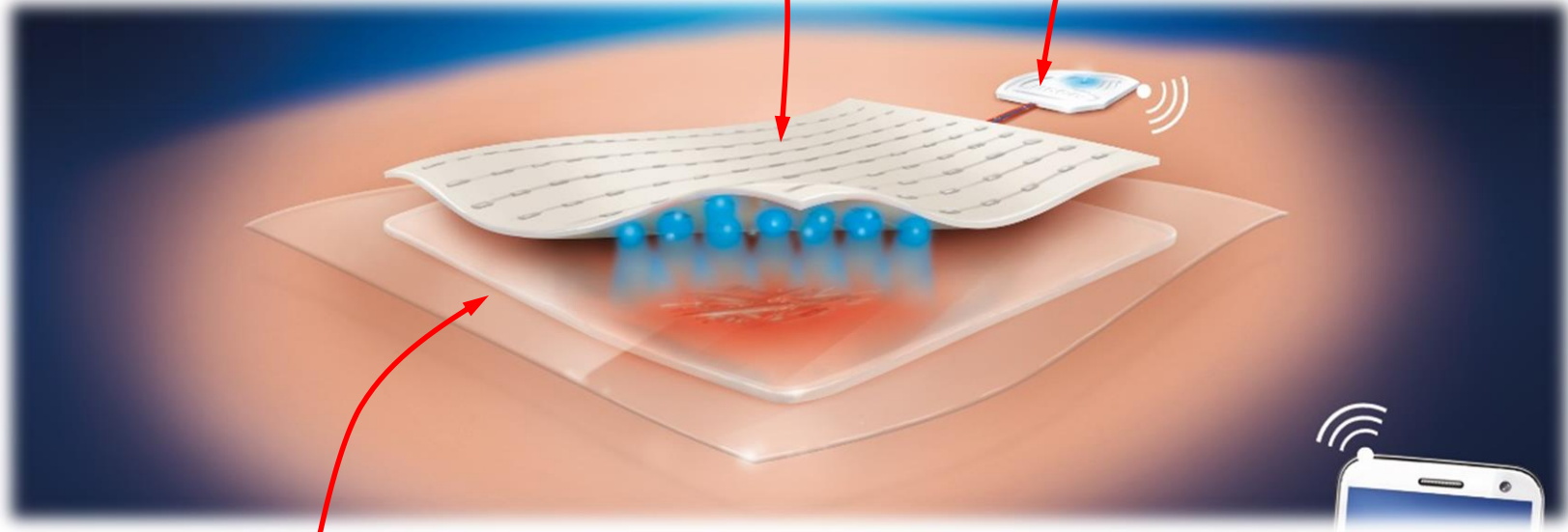
Flexible, Heat Management, Breathability
(re-usable on the same patient)

2. Electronics

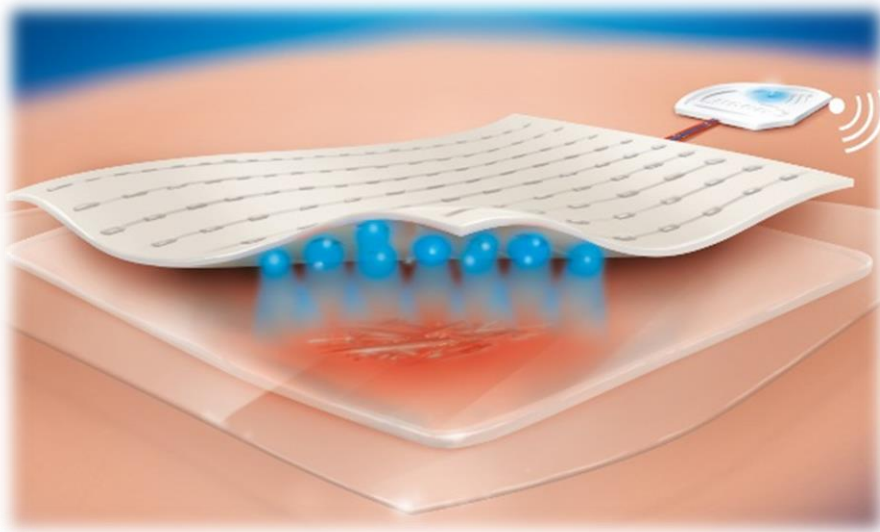
Controlling, Logic, Wireless,
Battery (non-disposable)

3. URGO Wound Dressing

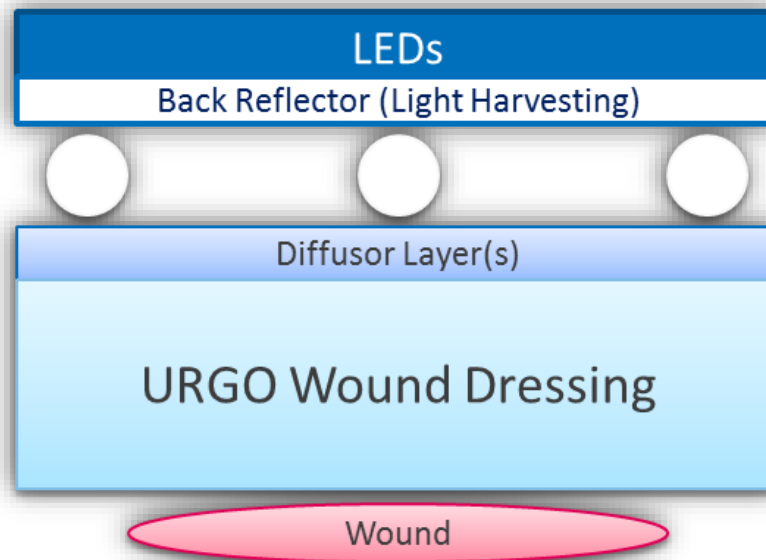
Several functional layers



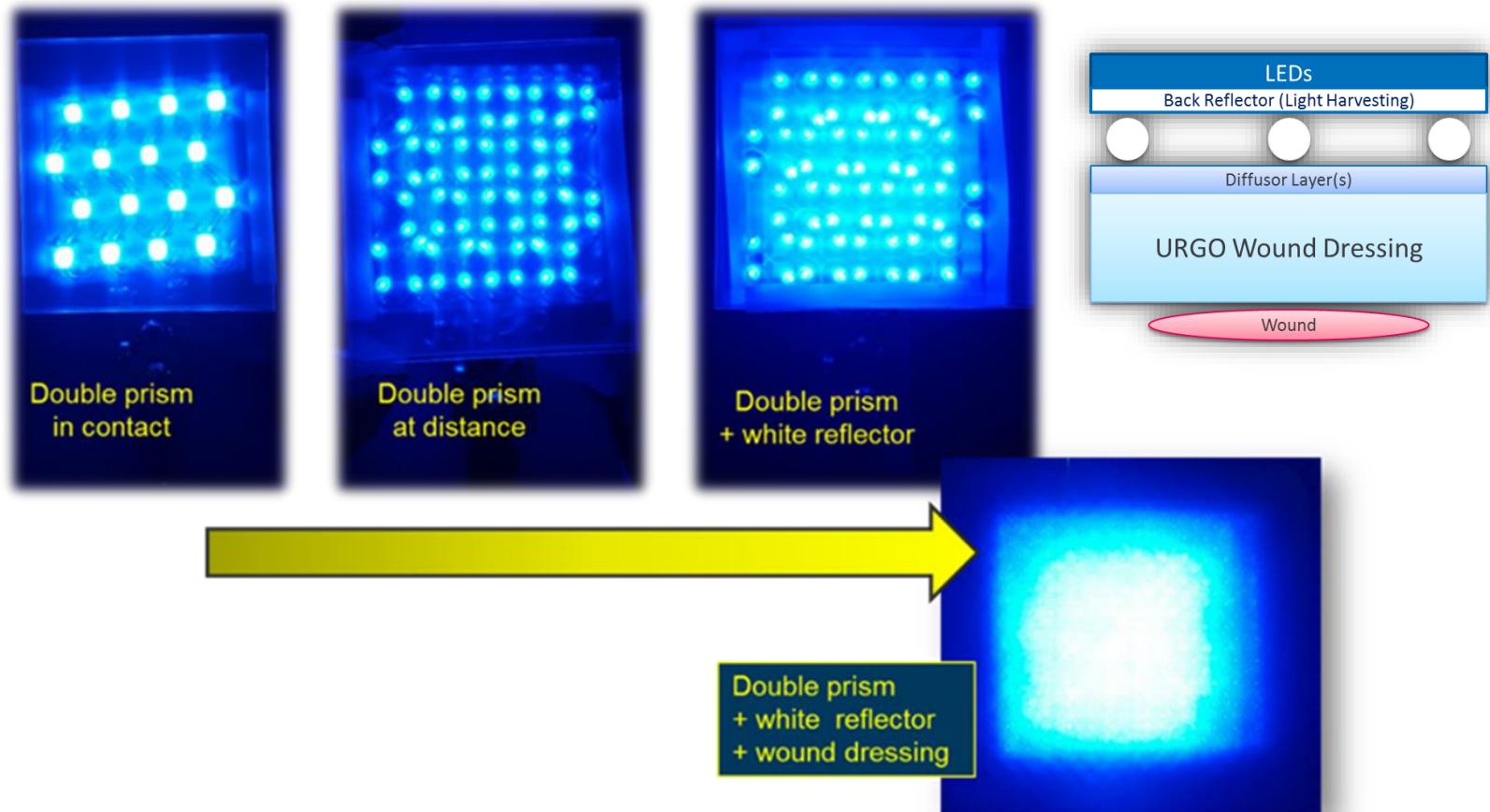
The MEDILIGHT System



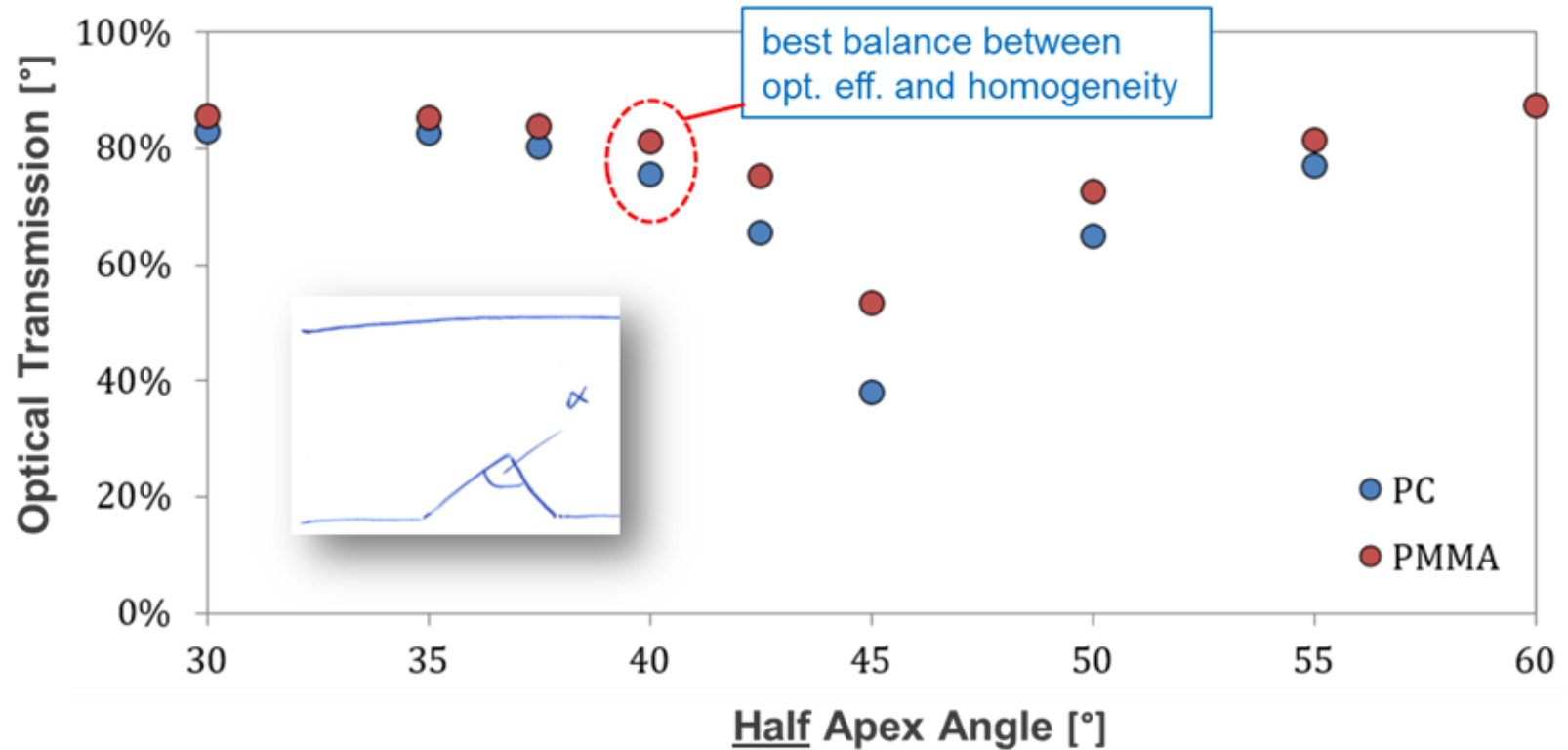
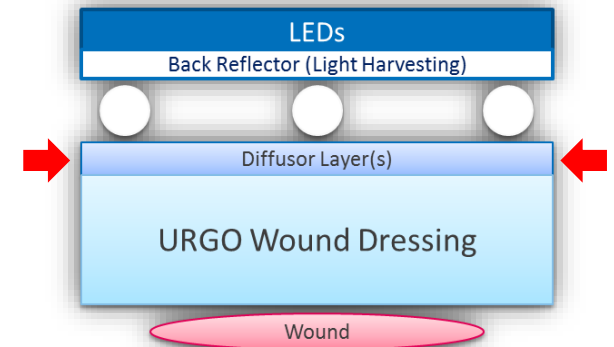
The Illumination System



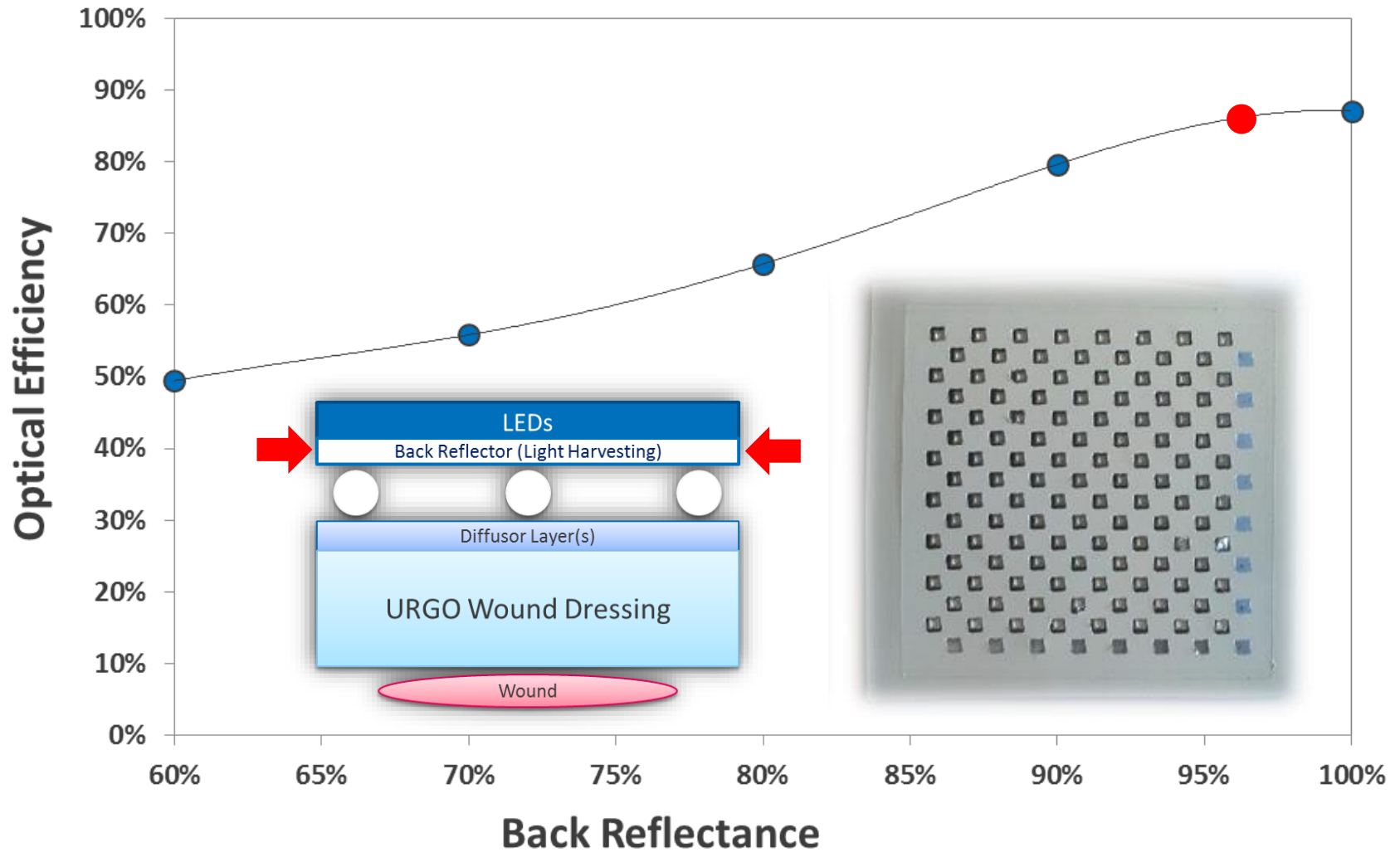
The Illumination System – Example Prismatic Diffusor



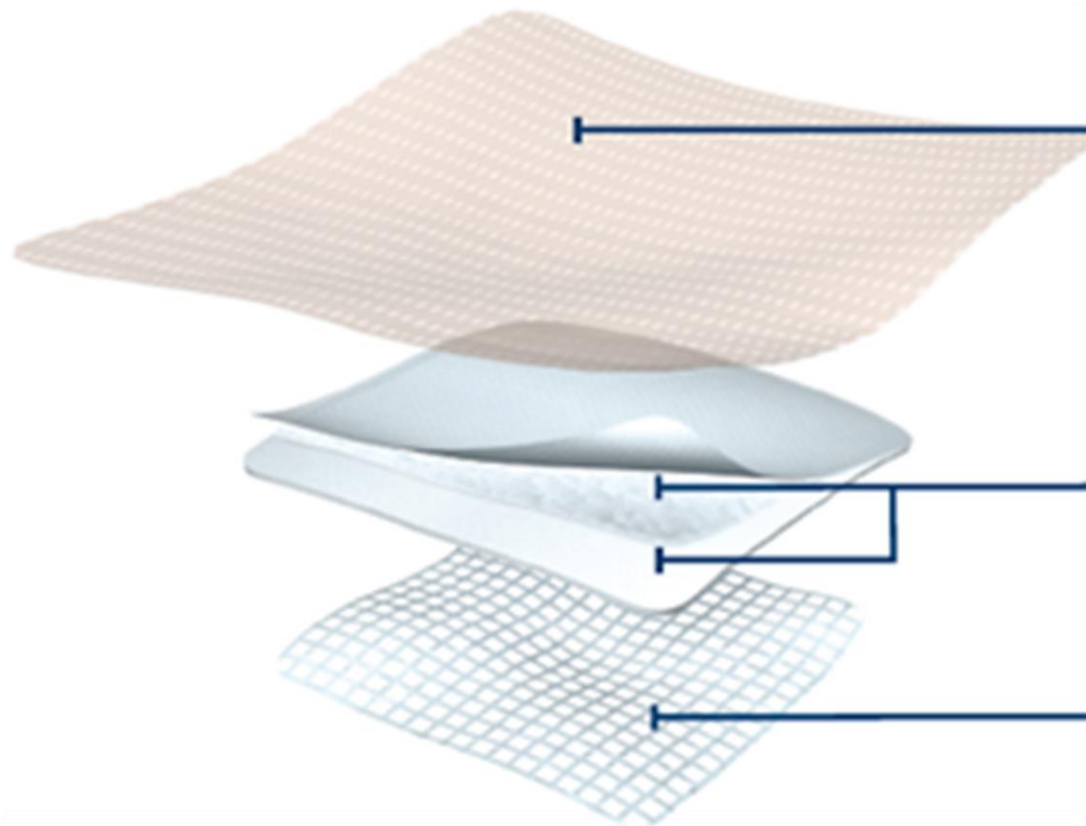
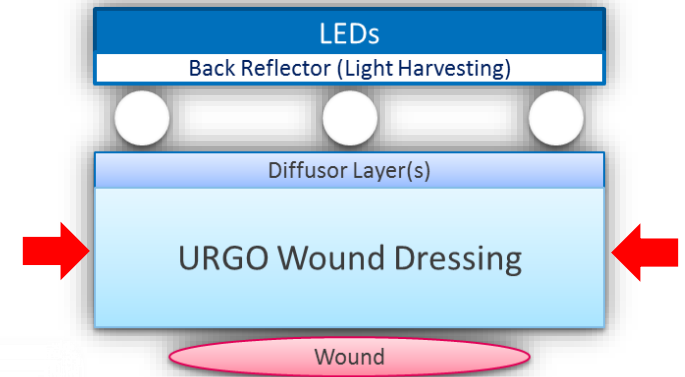
Diffusor: Efficiency vs. Homogeneity



Illumination System – Increased Back Reflectance



The URGO Wound Dressing

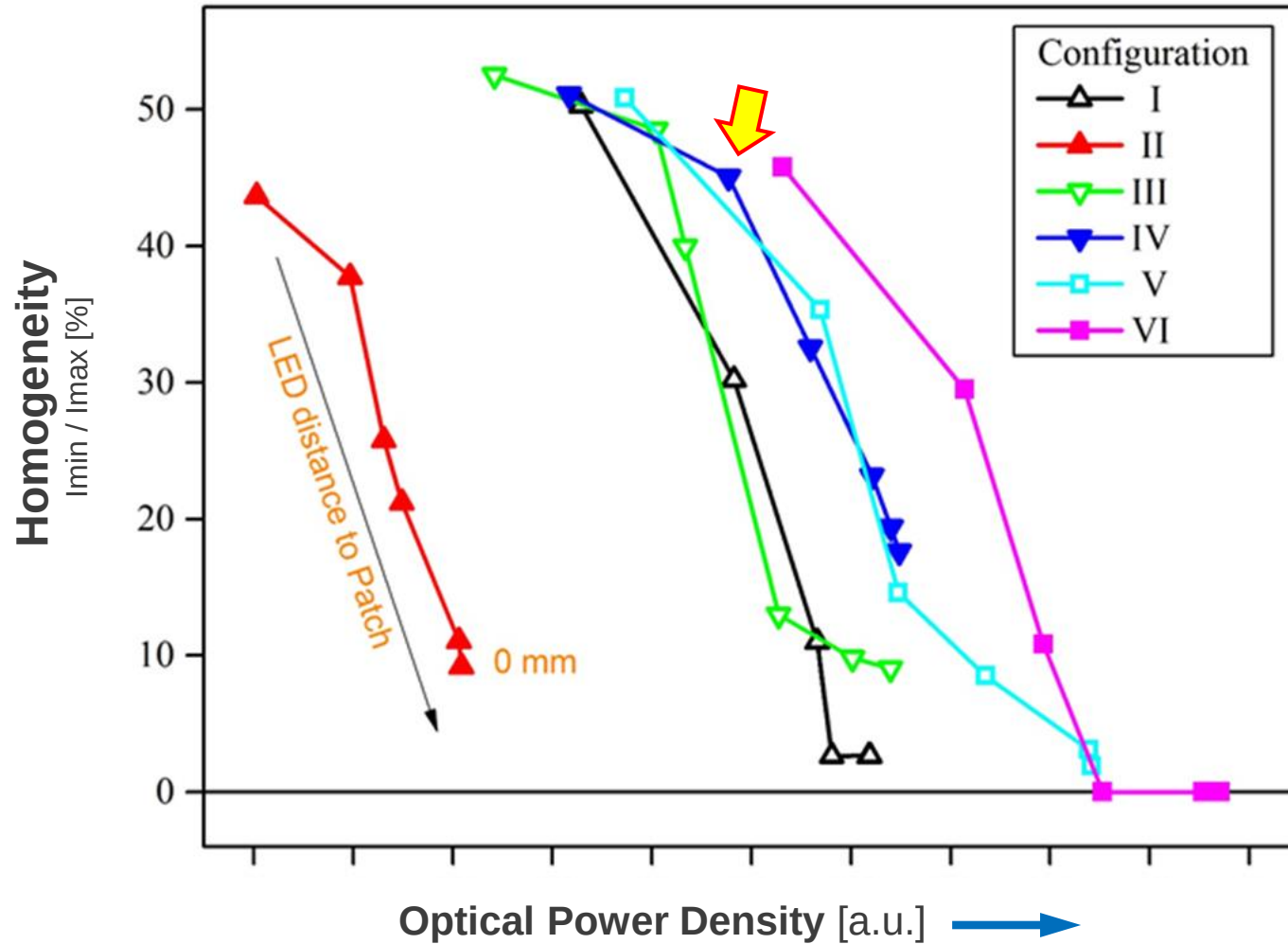


Waterproof backing

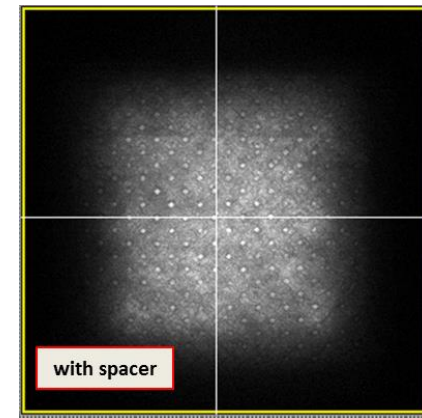
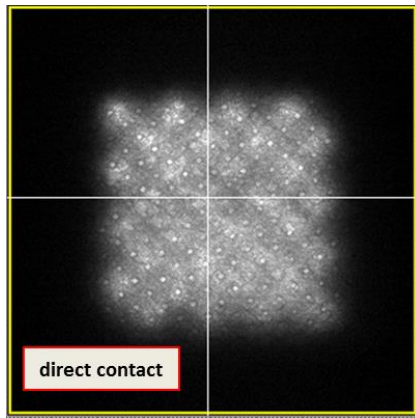
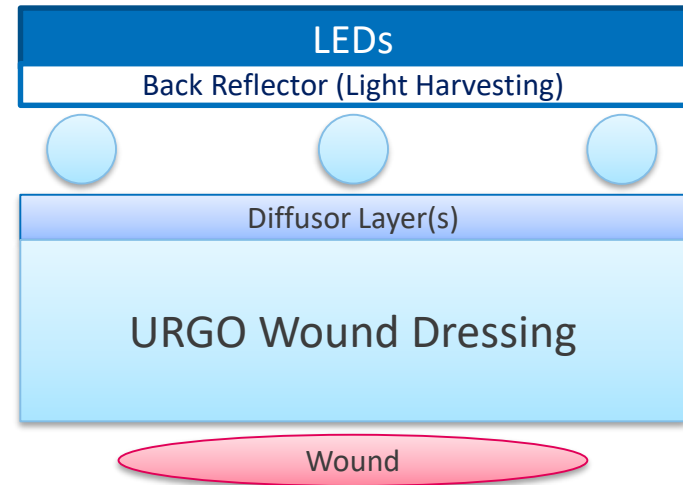
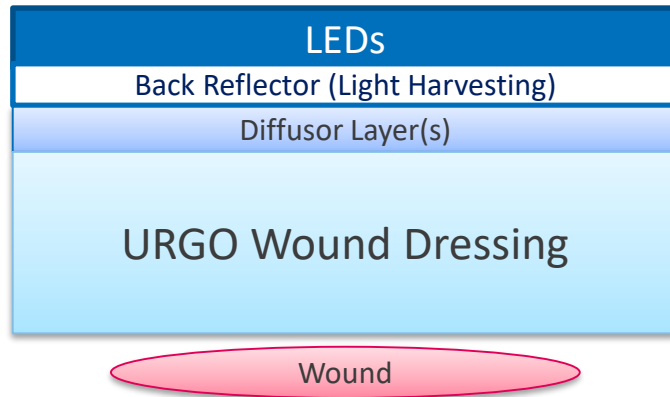
Highly absorbing layers

Soft adherent layer
(in contact with the wound)

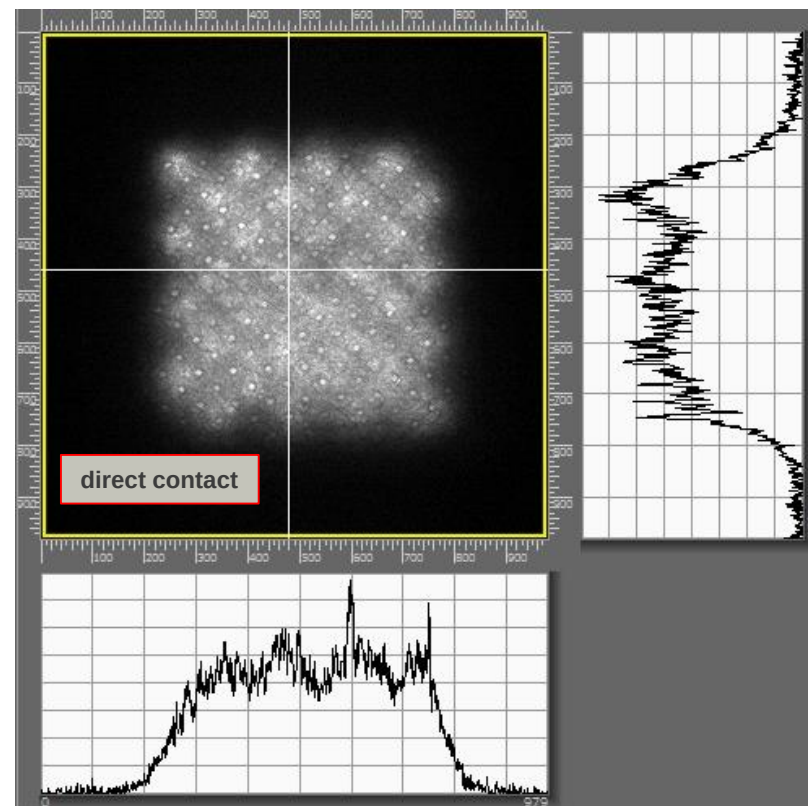
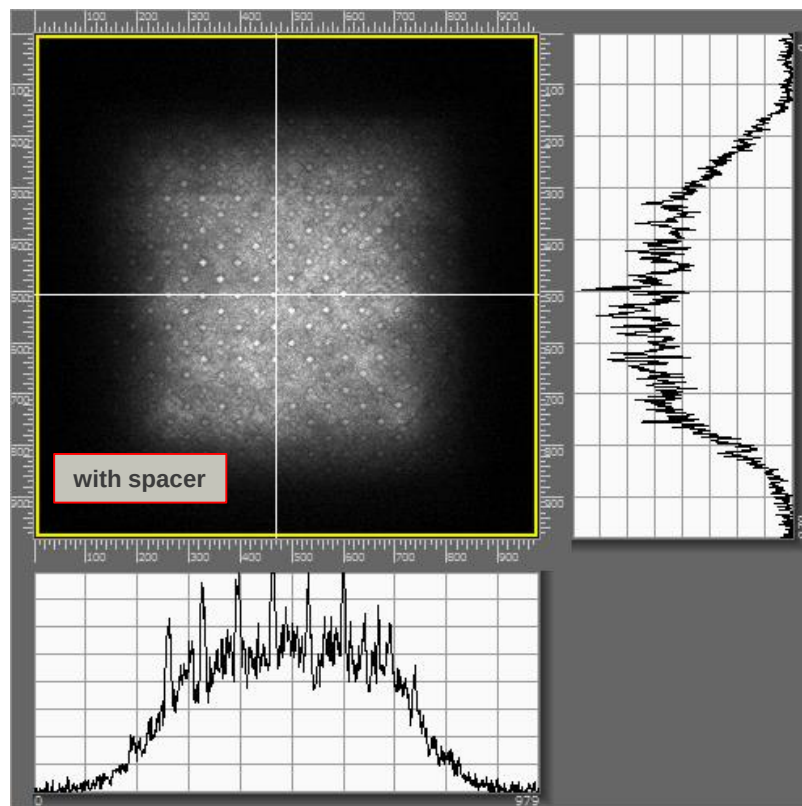
The Illumination System – Diffusor Measurements



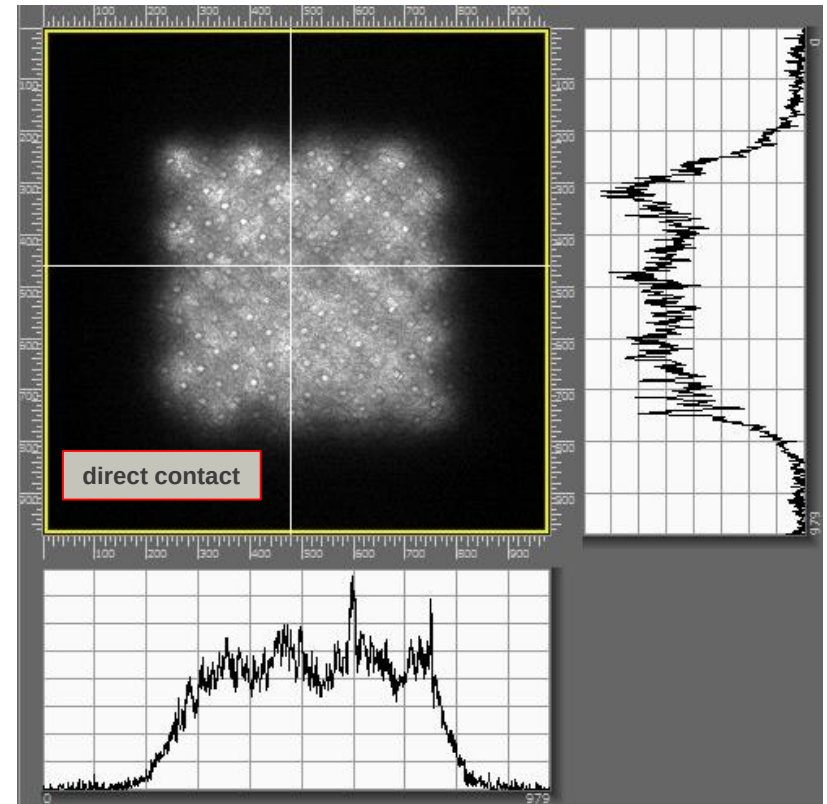
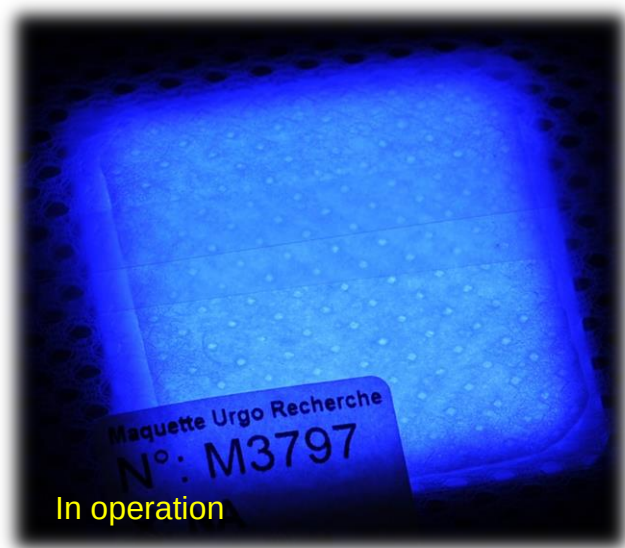
Illumination System – Final Design



Illumination System – Homogeneity



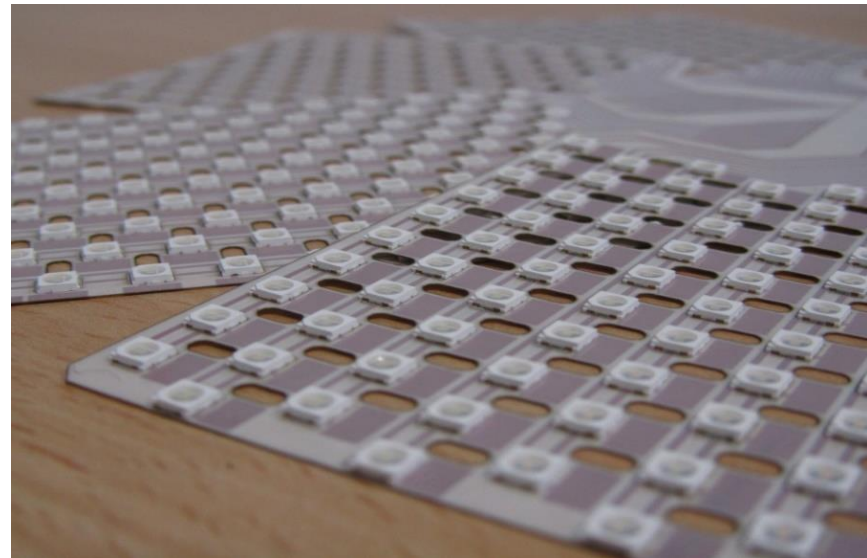
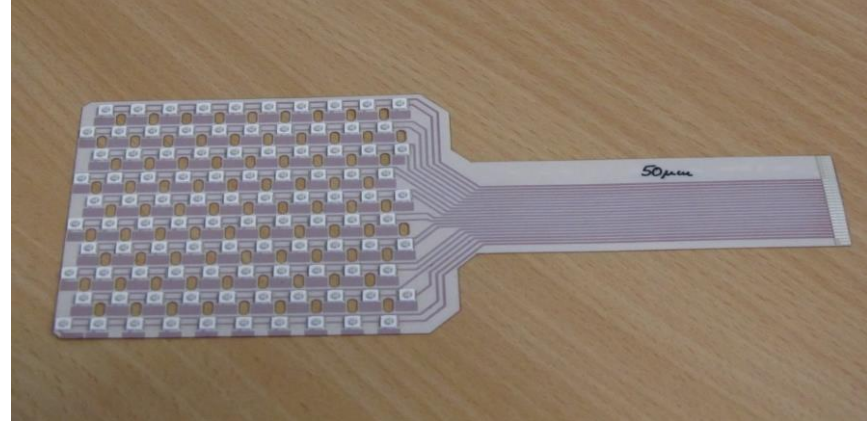
Illumination System – Homogeneity



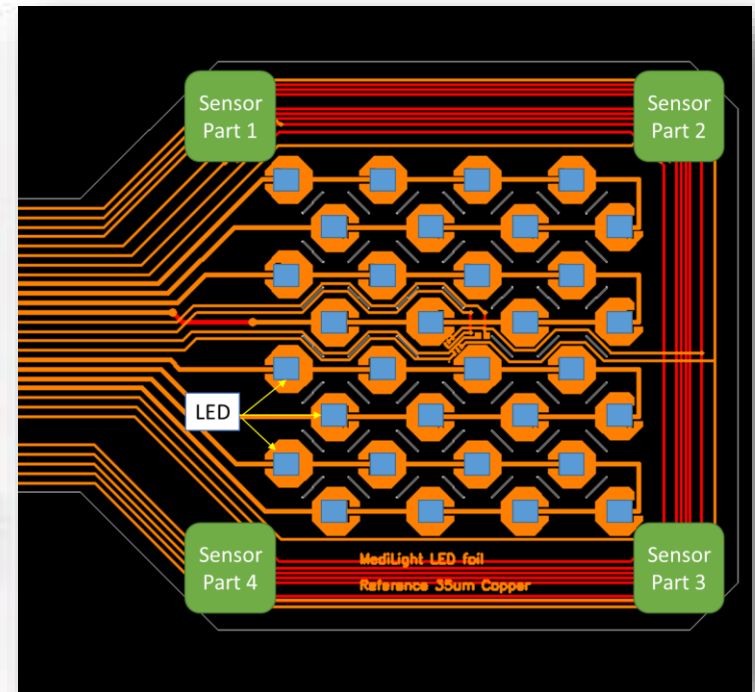
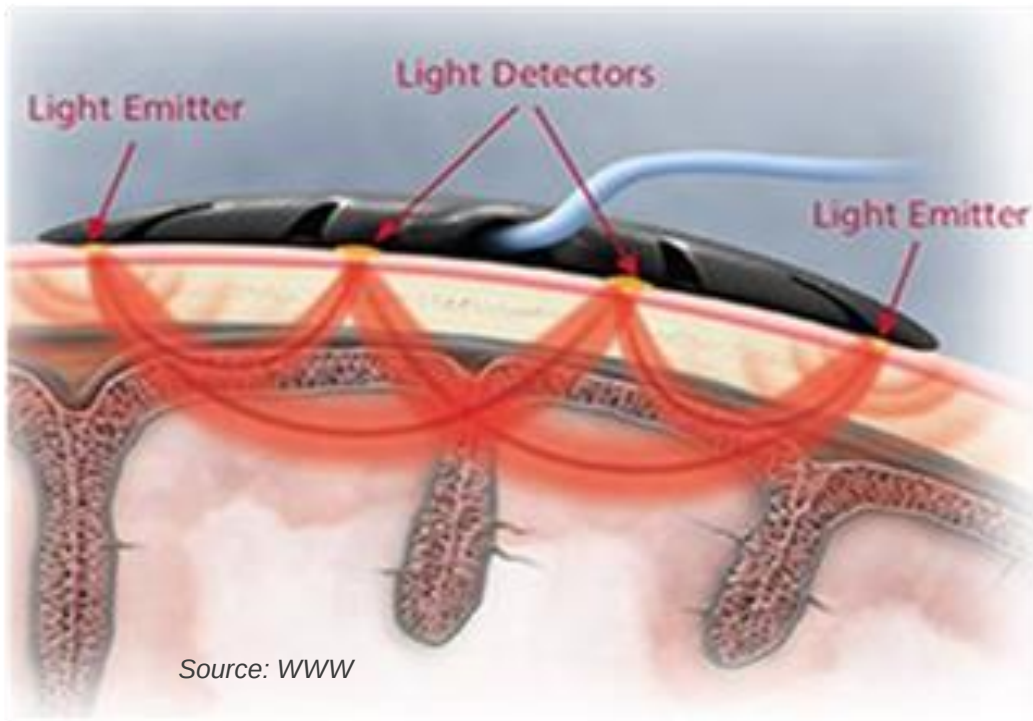
Electronics & Software



Flexible LED Foil Prototype (substrate made of PEN)

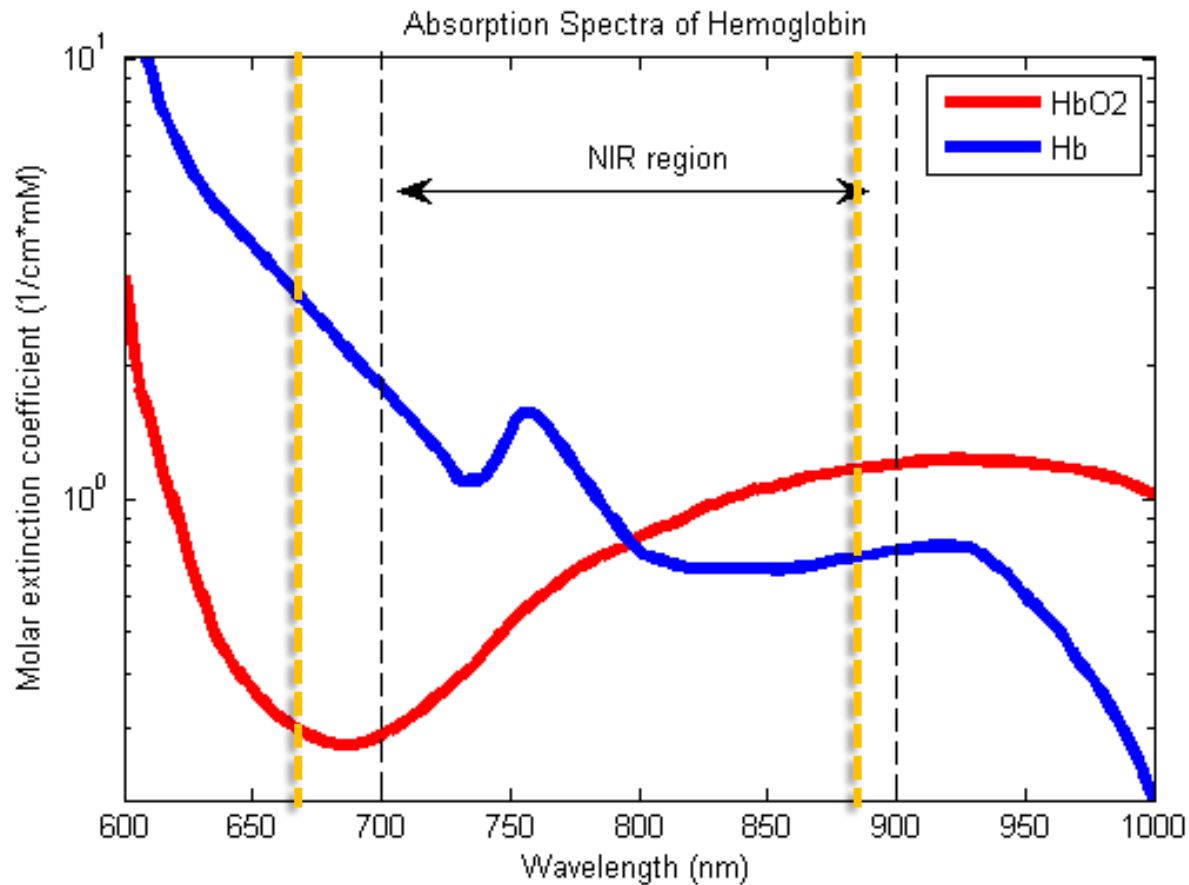


Measurement of Blood Oxygenation



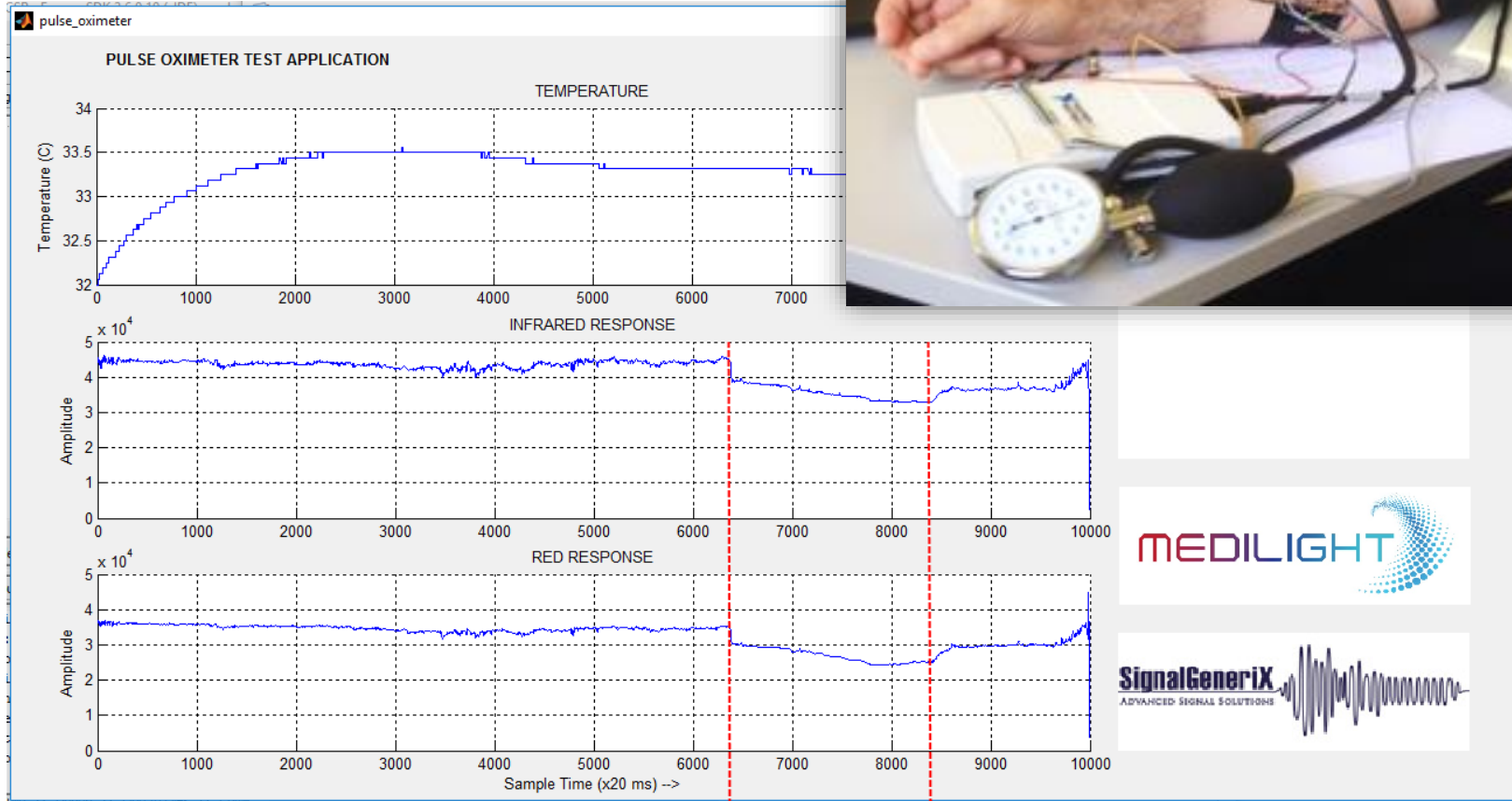
$$S_pO_2 = \frac{HbO_2}{HbO_2 + Hb}$$

Absorption of Light in (Oxygenated) Hemoglobin



Source: Wikipedia

Oxygenation & Temperature



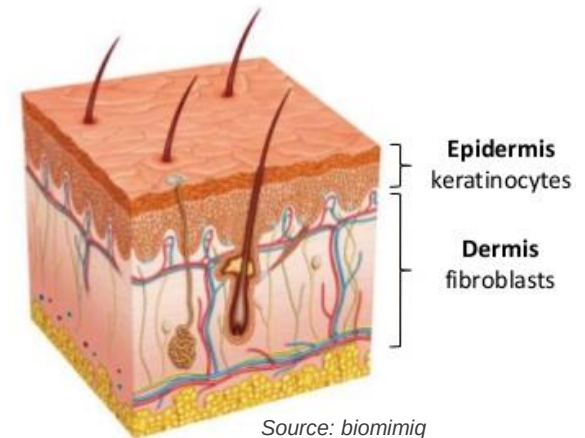
$$\frac{V_{red}}{V_{IR}} = \frac{V_{rms}(RED) - V_{DC}(RED)}{V_{rms}(IR) - V_{DC}(IR)} \rightarrow \text{SpO}_2$$

Pressure
Applied

Pressure
Released

In-Vitro Testing of Bacteria and Skin Cells

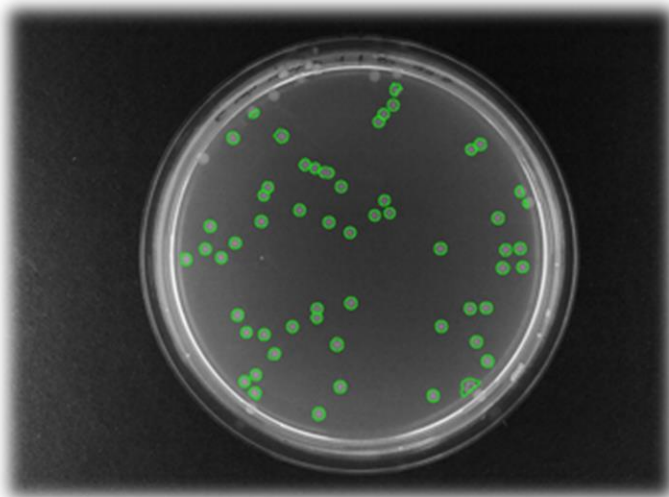
The Different Healing Stages



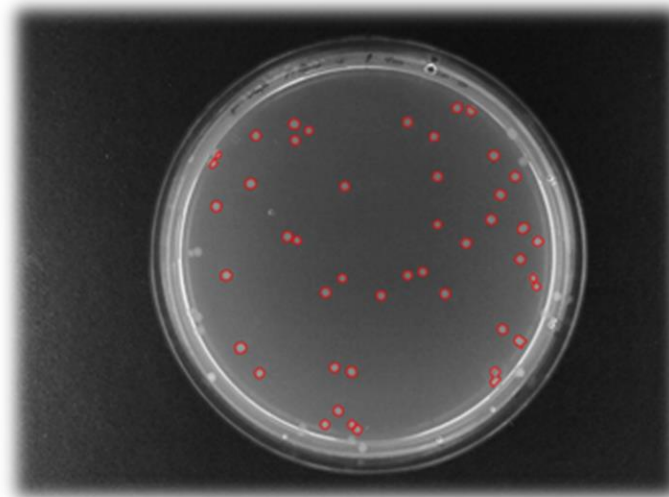
Healing stage	Infection (Bacteria)	Cleansing (Macrophages)	Granulation (Fibroblasts)	Epidermisation (Keratinocytes)
Purpose	- Limitation of cell proliferation - Inhibition of virulence - Formation of biofilm	- Modulation of macrophage activity (inflammation mediators) - Enhancement of granulation phase	- Proliferation - Migration - Dermis synthesis (collagen)	- Proliferation - Migration - Differentiation
Light Schedule	Confidential Data			
Device Application	Permanent	Permanent	Permanent	Permanent
Sensors	Temperature O ₂	Temperature O ₂	O ₂	O ₂

In-Vitro Testing of Bacteria

- Image analysis software „ZMFsoft“ developed
- Different blue light irradiation times and cycles tested
- Image acquisition performed 24h after irradiation
- Evaluation of colony count, area, radius and eccentricity
- Subsequent statistical comparison between the light and control experiments
- Growth inhibiting effects were found for different strains (**details are confidential**)



Control plate

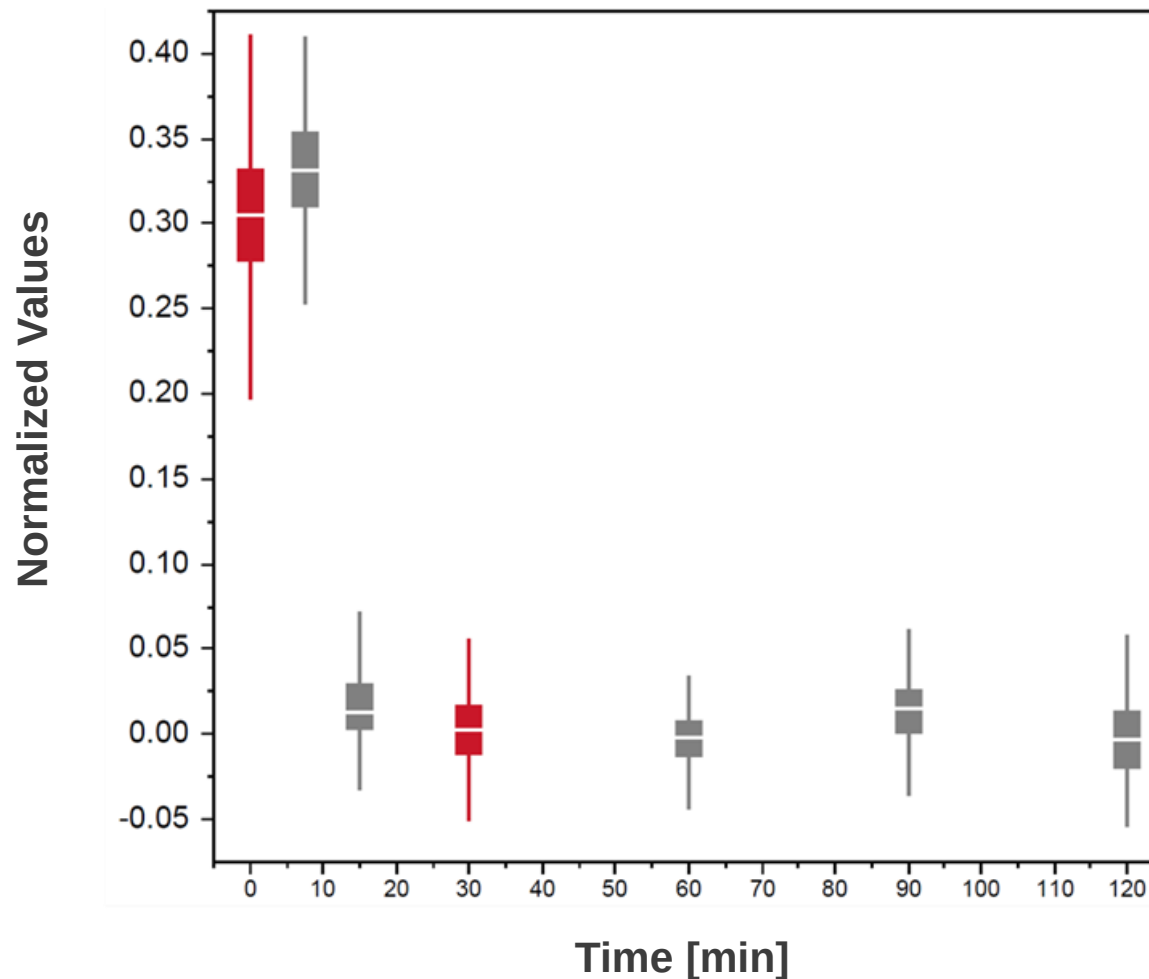


Light-treated plate

→ **Reduction of colony size!**

Prevention of Overshooting Epidermisation

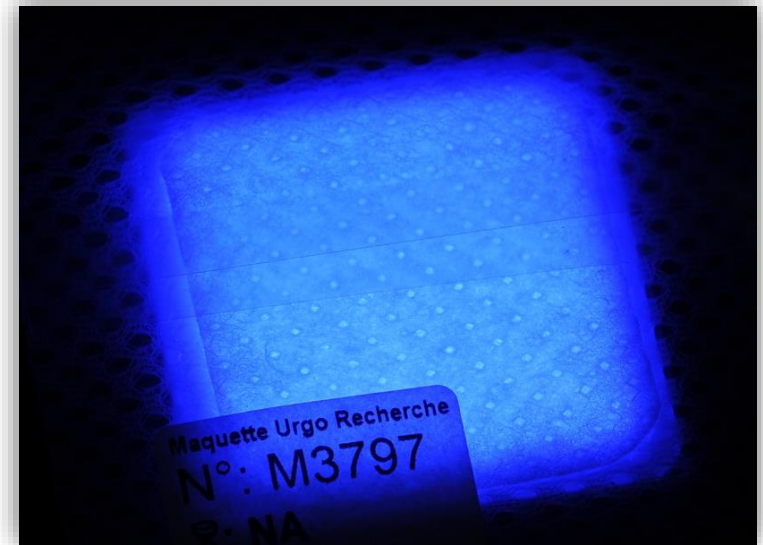
preventing the wound to close too early (in premature healing phase)



Conclusion

MEDILIGHT...

- treats chronic wounds with blue light
- flat, flexible, and homogenous illumination system
- Breathability (management of patient's exudates)
- Heat Management (from LEDs)
- Measurement of blood oxygenation
- Monitoring the temperature
- Growth of bacteria was significantly reduced
- Indications for proliferation of skin cells
- Overshooting of skin cell growth in early wound healing phase was prevented



Thank you for your attention.

Basel, Switzerland