**Light-enhanced Transdermal Drug Delivery**

Rabah Boukherroub

Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, IEMN, UMR CNRS 8520, F-59000 Lille, France

E-mail: rabah.boukherroub@univ-lille.fr

Advances in materials science and bio-nanotechnology have allowed the refinements of
current drug delivery systems, expected to facilitate the development of personalized medicine. While dermatological topical pharmaceutical formulations, such as foams, creams, lotions, gels, etc., have been developed and used for decades, these systems target mainly skin-based diseases. To treat systemic medical conditions as well as localized problems such as joint or muscle diseases, transdermal delivery systems (TDDSs), which use the skin as the main route of drug delivery, are very appealing.

Over the years, these systems have shown to offer important advantages over oral as well as
intravenous drug delivery routes. Besides being non-invasive and painless, TDDSs are able to deliver drugs with a short-half-life time more easily and are well-adapted to eliminate frequent administrations to maintain constant drug delivery.

However, the transdermal market still remains limited to a narrow range of drugs. While small and lipophilic drugs have been successfully delivered using TDDSs, this approach fails to deliver therapeutic macromolecules due to size-limited transport across the *stratum corneum*, the outermost layer of the *epidermis*. The low permeability of the *stratum corneum* to water soluble drugs as well as macromolecules poses important challenges to transdermal administration.
To widen the scope of drugs for transdermal delivery, new procedures to enhance skin
permeation to hydrophilic drugs and macromolecules are under development. Next
to iontophoresis and microneedle-based concepts, thermal-based approaches have
shown great promise to enhance transdermal drug delivery of different therapeutics.

In this presentation, I will discuss our original contribution on the on-demand delivery of drugs
*via* light activation for the treatment of chronic diseases, such as diabetics, hypertension, but also for wound treatment.

**References**

(1) Photothermal activatable mucoadhesive fiber mats for on-demand delivery of insulin via buccal and corneal mucosa. Voronova *et al., ACS Applied Bio Materials* 5 (**2022**) 771-778

(2) Innovative transdermal delivery of insulin using gelatin methacrylate-based Microneedle Patches in Mice and Mini-pigs. Demir iet al., *Nanoscale Horizons* 7 (**2022**) 174-184, **Cover Page**

(3) Managing Diabetes using Nanotechnology: Present and Future Concepts

Szunerits iet al., *Chemical Society Reviews* 50 (**2021**) 2102-2146

(4) Electrothermal patches driving the transdermal delivery of insulin

Pagneux *et al.*, *Nanoscale Horizons* 5 (**2020**) 663-670, **Cover page**

(5) Heat: A Highly efficient Skin enhancer for Transdermal Drug Delivery
S. Szunerits and R. Boukherroub, *Frontiers in Bioengineering and Biotechnology* 6 (2018) 151
(6) Photothermally triggered On-Demand Insulin Release from Reduced Graphene Oxide modified Hydrogels

Teodorescu *et al., Journal of Controlled Release* 246 (**2017**) 164–173