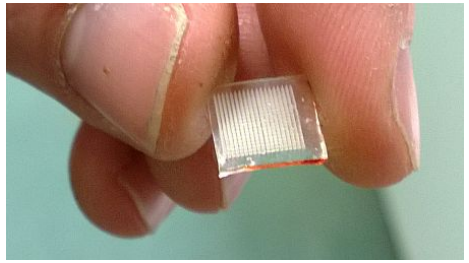
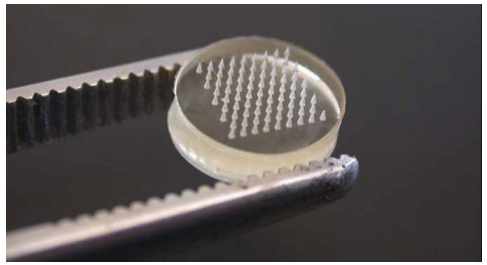
Novel microneedles array design and nanocapsules; A promising drug delivery system to improve the intradermal delivery and photodynamic activity of Hypericin to skin melanoma cancer





Heba Abdelwahab* - Ismaiel Tekko – Ryan Donnelly

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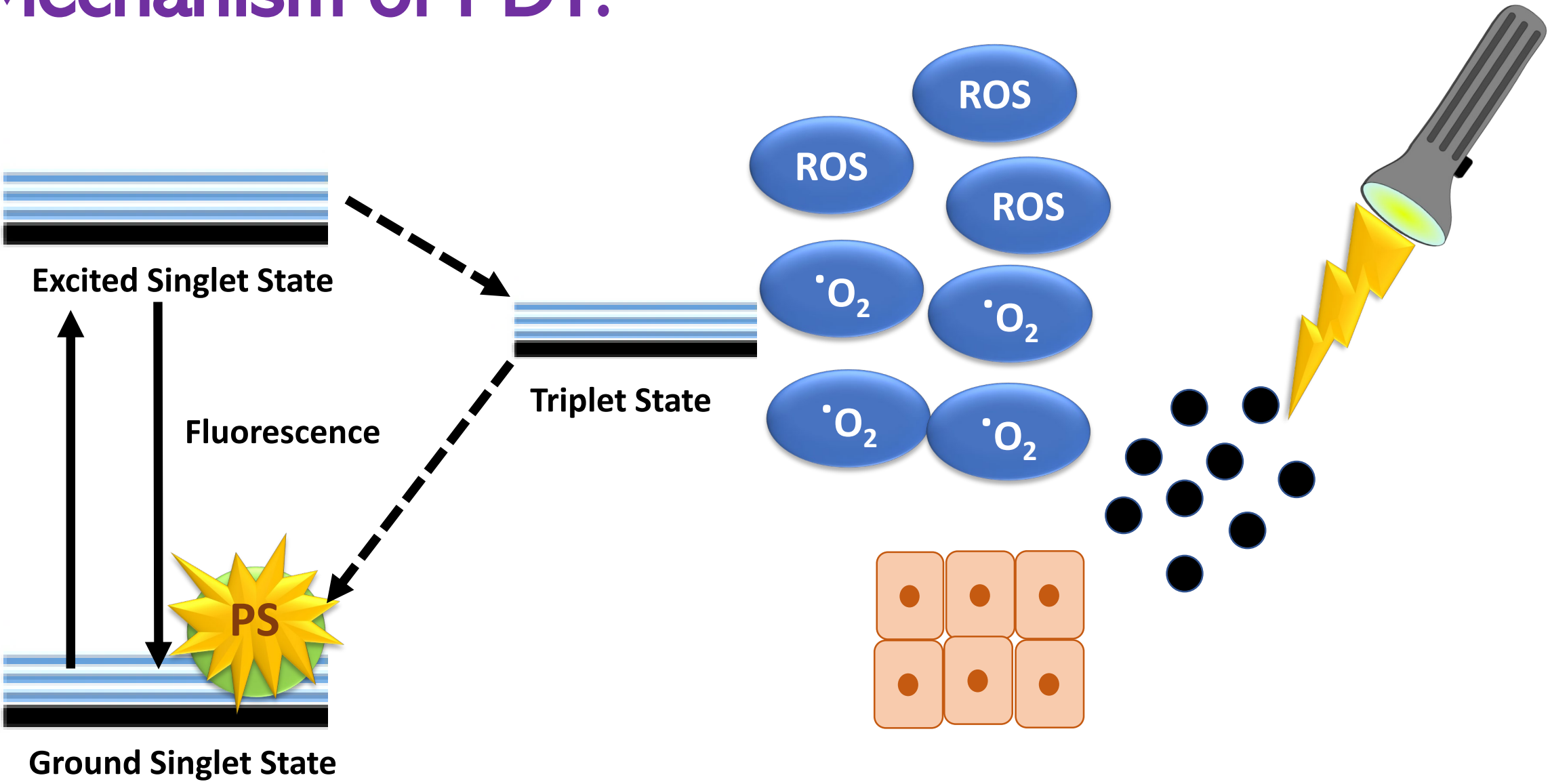
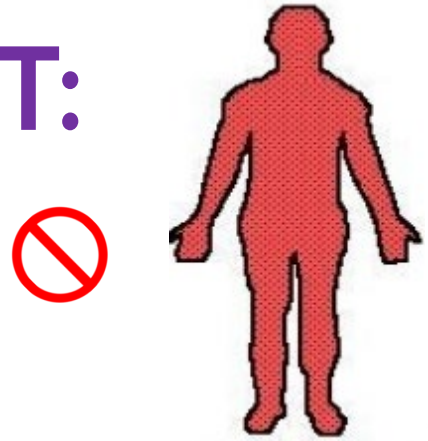
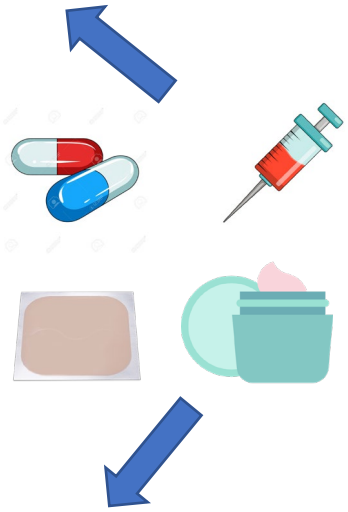
Photodynamic therapy (PDT):

Mechanism of PDT:

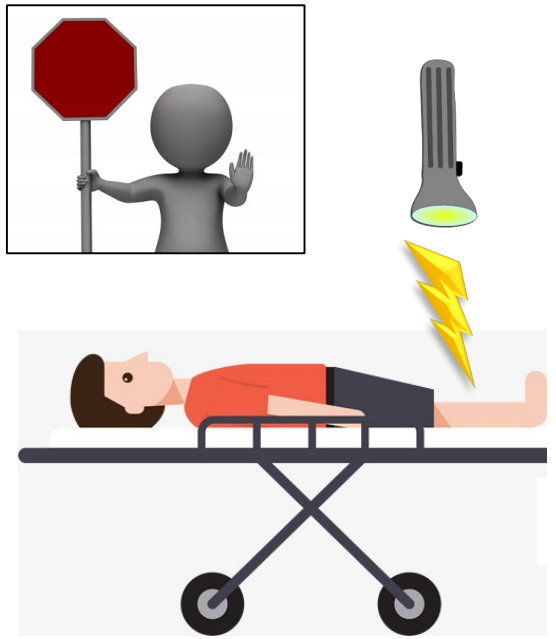


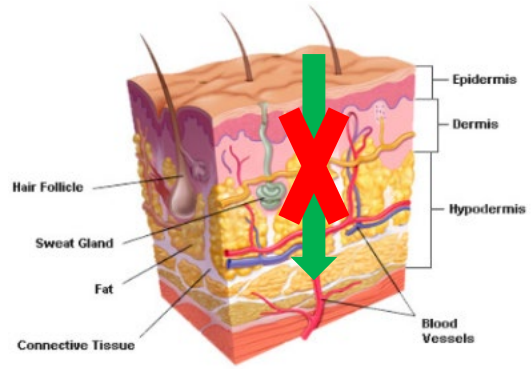
PDT:





Hours





ROS $^{\cdot}O_2$

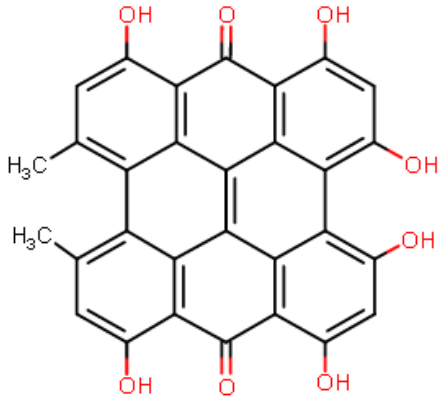
ROS $^{\cdot}O_2$

Aim:

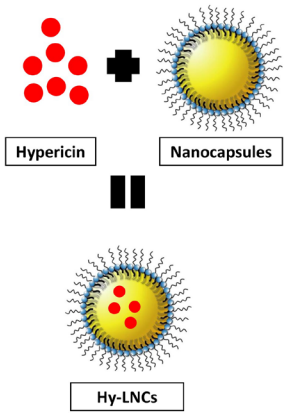
- ✓ Enhancing the **photodynamic** efficiency and the insufficient **skin penetration** of **Hypericin** by encapsulating the photosensitizer inside **LNCs** and then further incorporation into **microneedle** arrays.

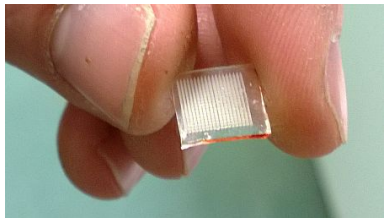
Hypericin; Advantages, Challenges

Hypericum Perforatum L. (St.John's Wort)



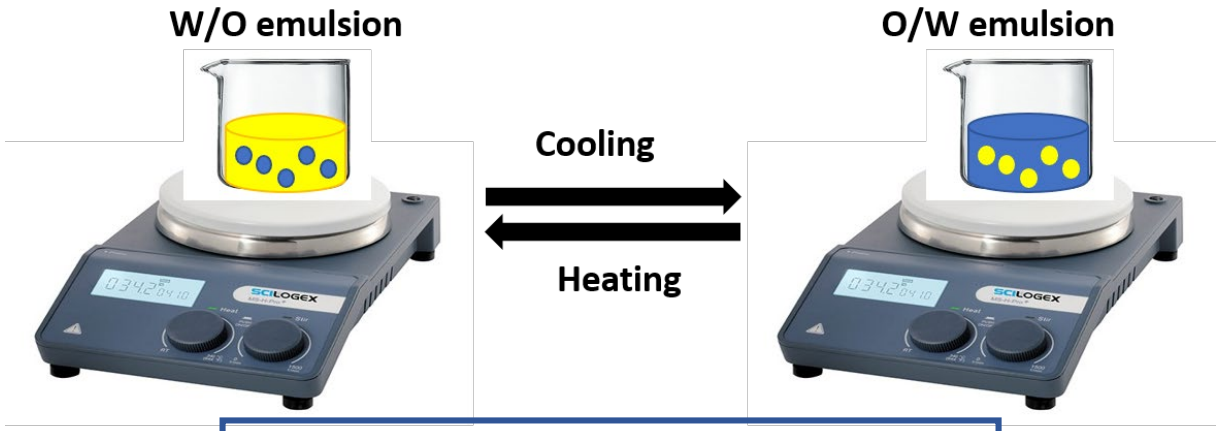
- ✓ 2nd generation PS.
- ✓ Very potent.
- ✓ Lipophilic.
- ✓ Many pharmacological activities; **anticancer**, antiviral and antimicrobial.



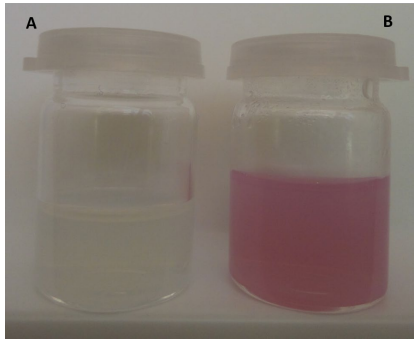


Methodology:

A- Lipid nanocapsules

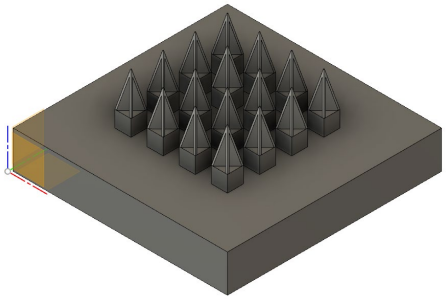


Phase inversion method

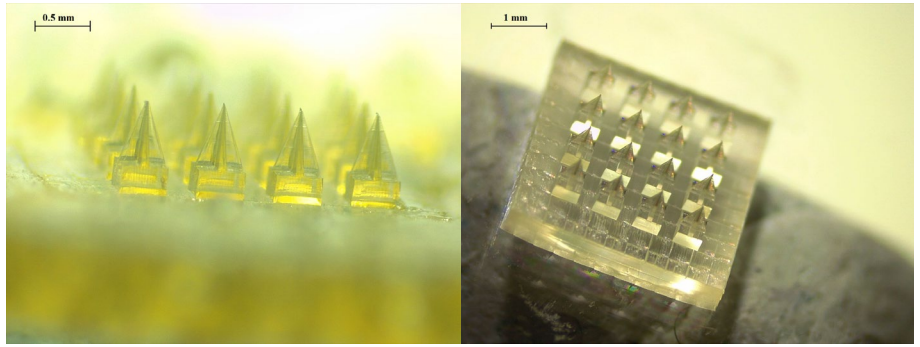


Blank LNC (A), Hy-LNCs (B)

B- Microneedles



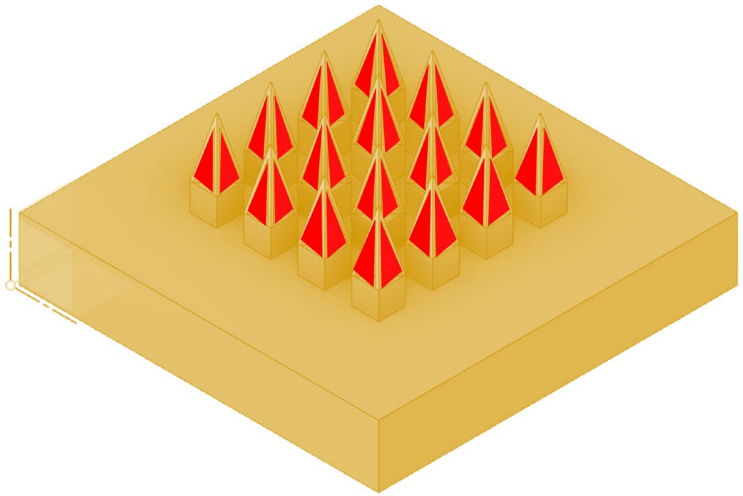
Male master mould



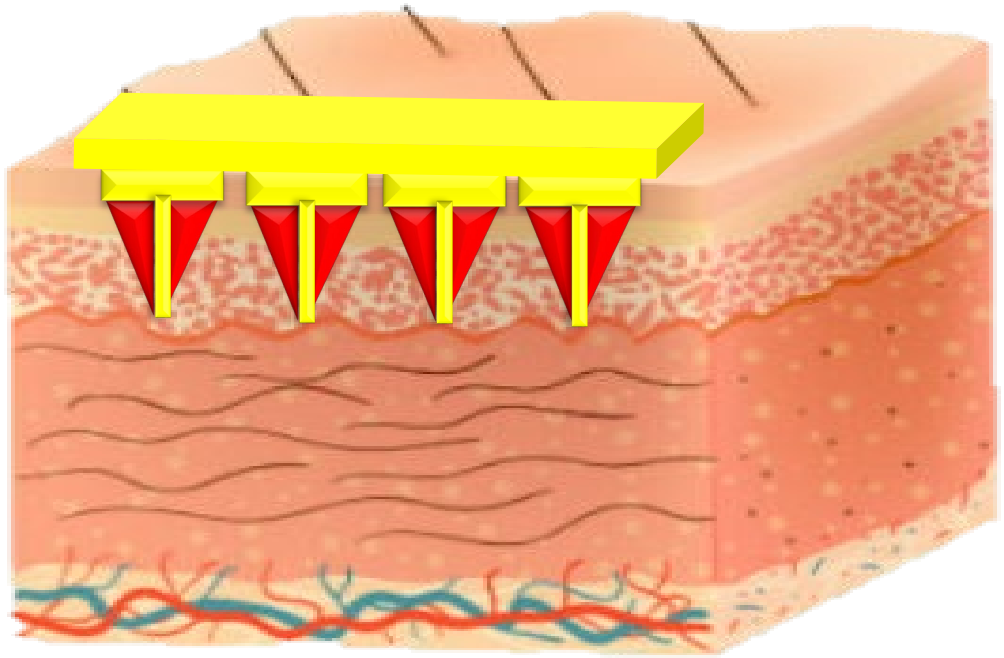
Microneedle arrays

Methodology:

C- Microneedles incorporating Hy-LNCs

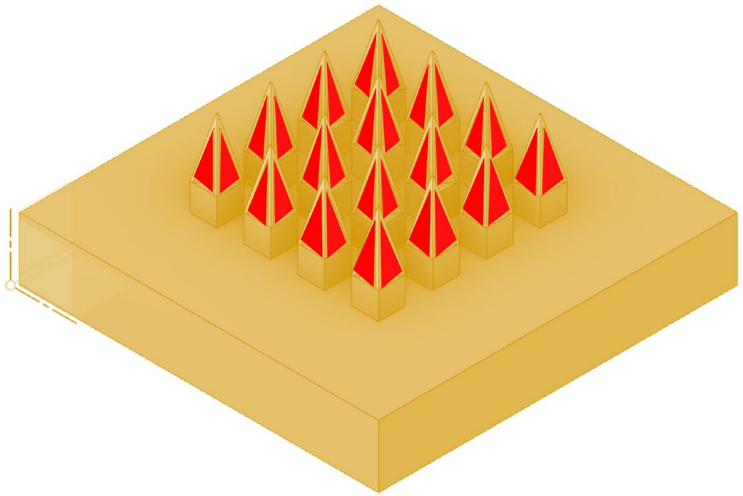


Hy-LNCs + Dissolving polymer matrix

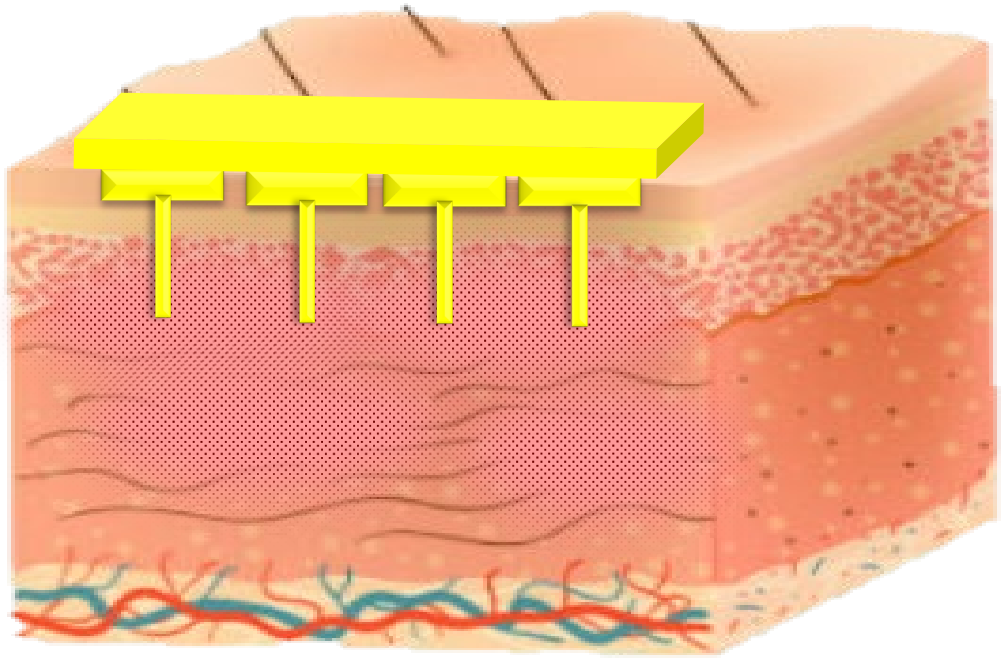


Methodology:

C- Microneedles incorporating Hy-LNCs

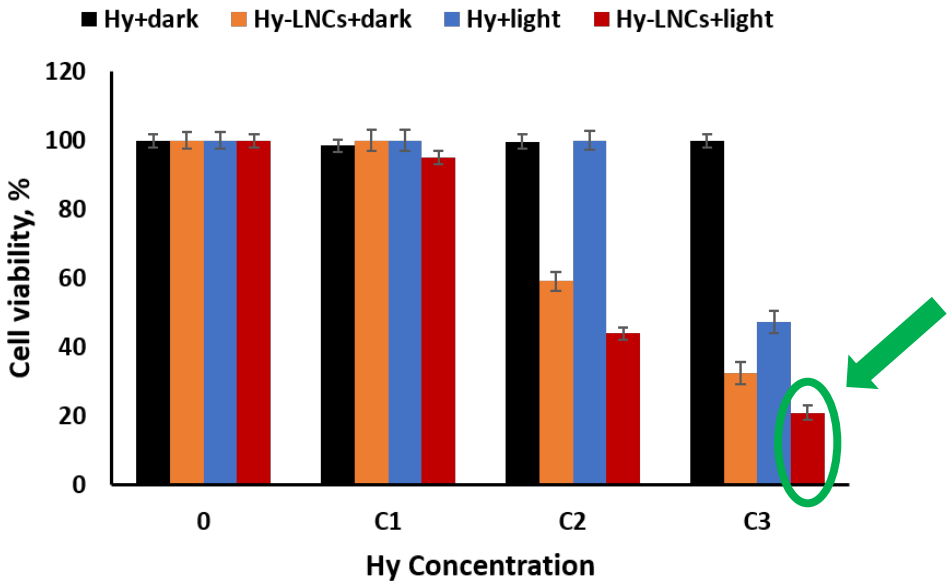


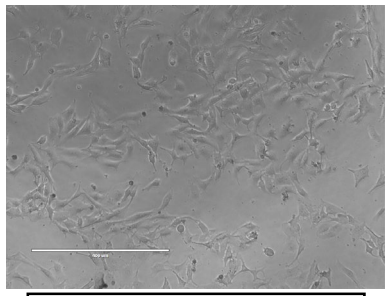
Hy-LNCs + Dissolving polymer matrix



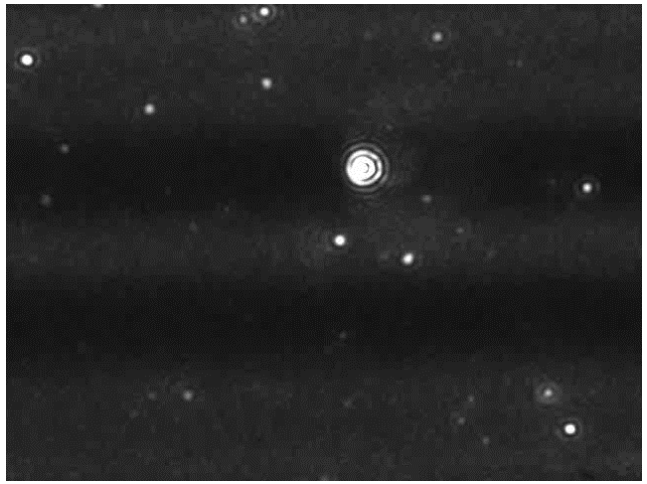
Key Results: A) LNCs

1) Photocytotoxicity study



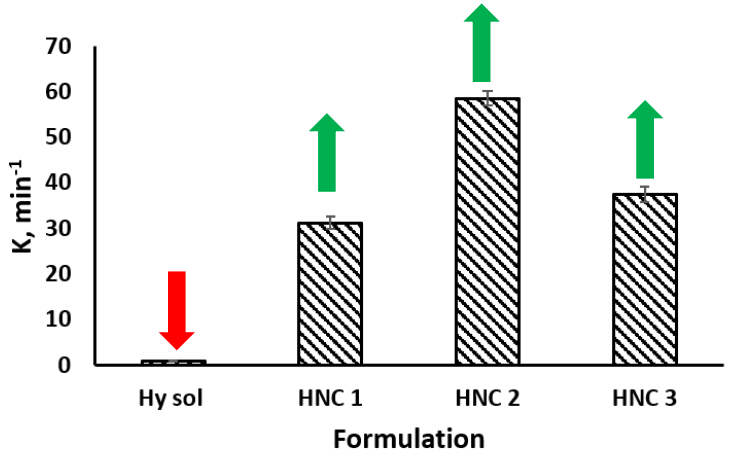


Melanoma cell line



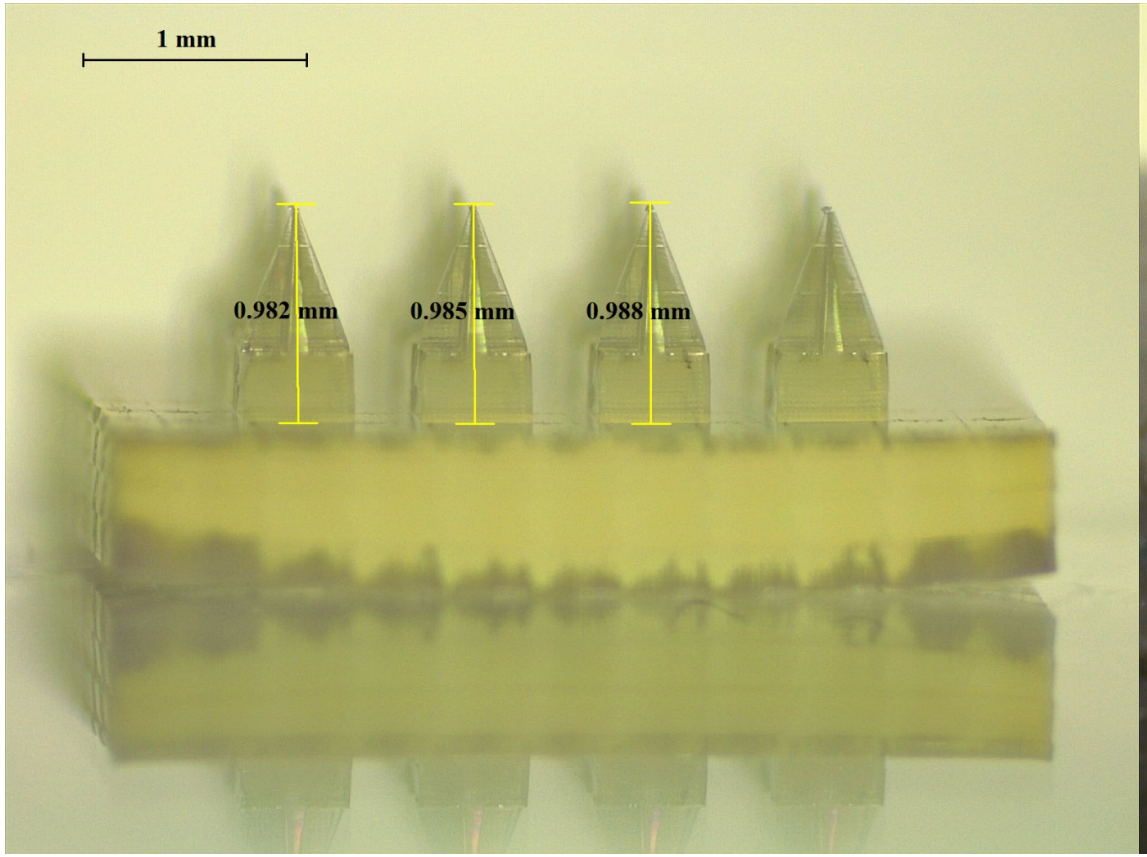
Imaging of Hy-LNCs using Nanosight NS 300.

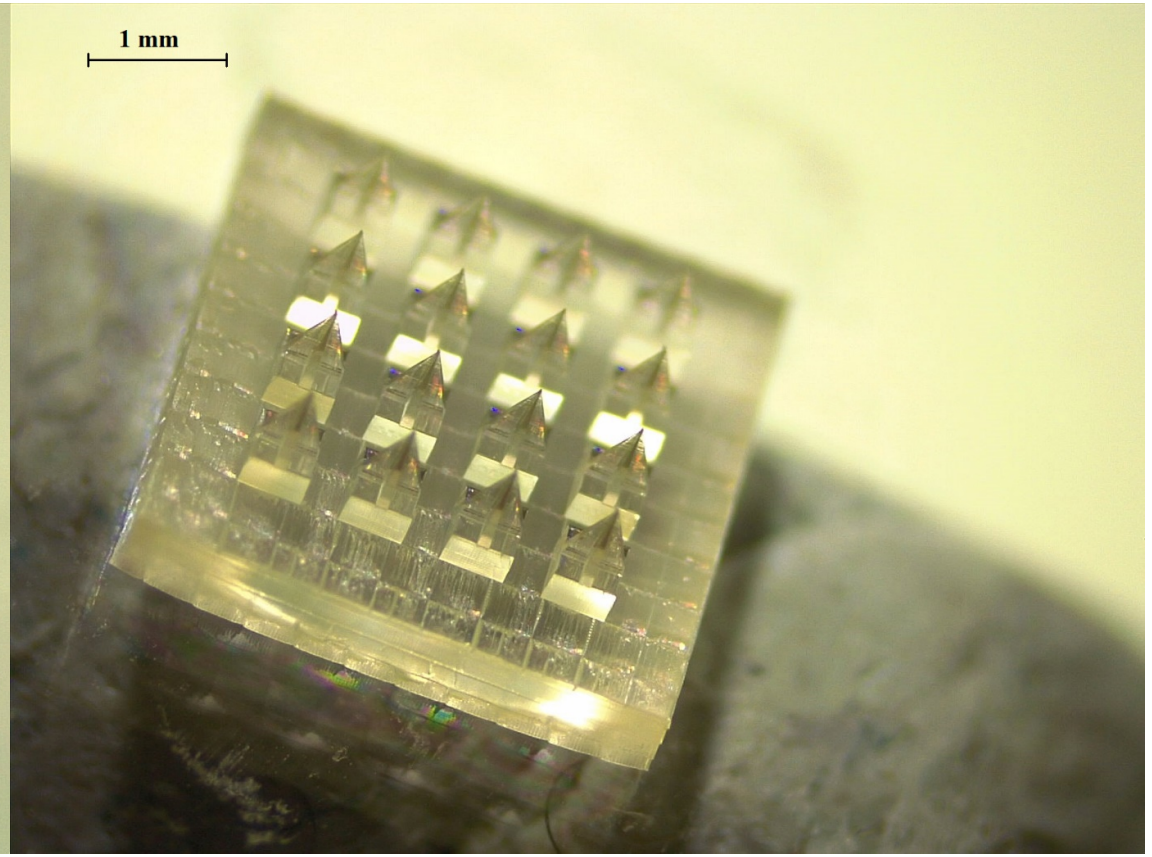
2) Photodynamic activity



K is the photodecomposition rate constant of the added singlet oxygen scavenger

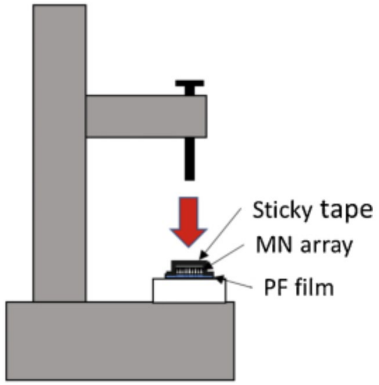
Key Results: B) Cross-shaped hydrogel microneedles



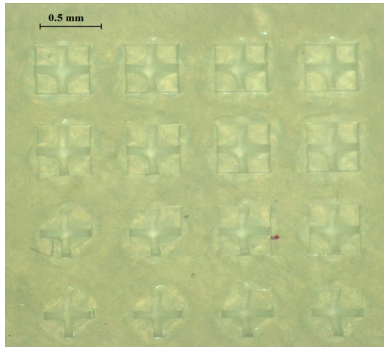


Key Results: B) Cross-shaped hydrogel microneedles

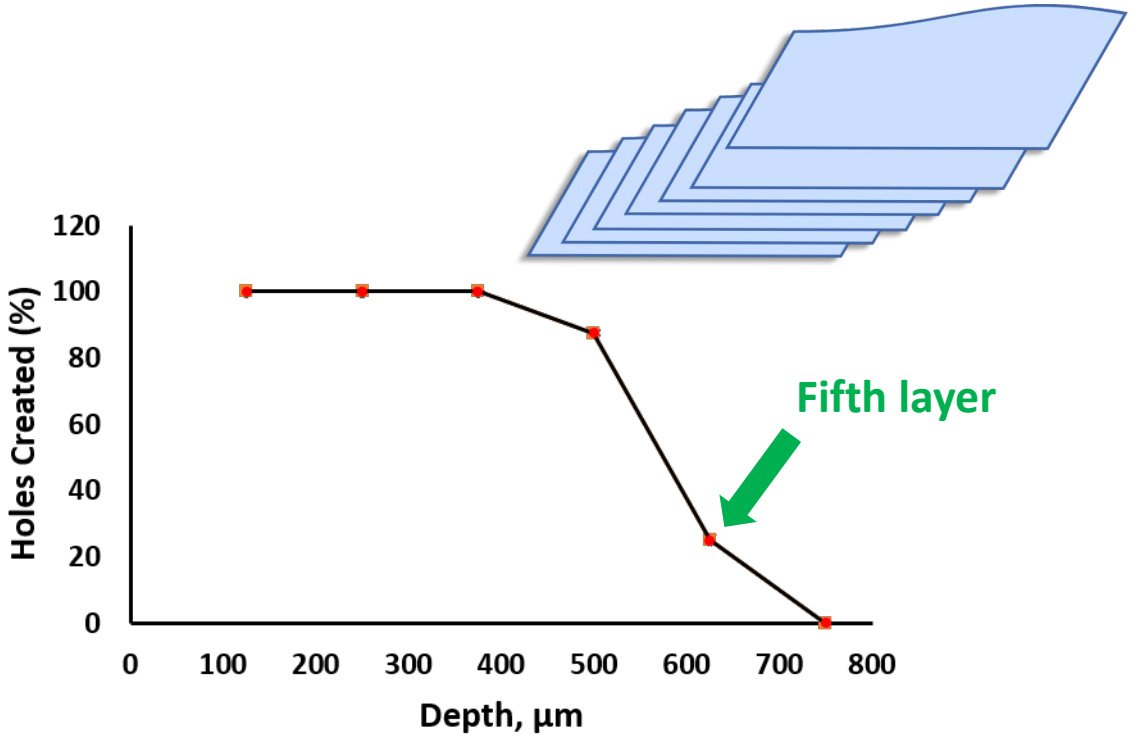
1) Parafilm insertion test



Texture Analyser set p for the insertion of MN arrays



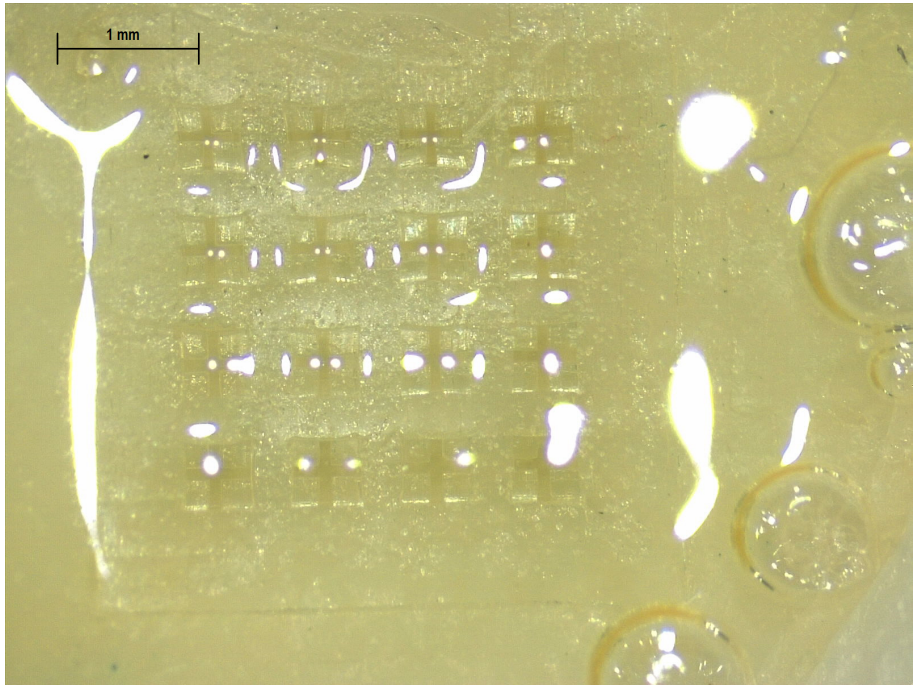
A light microscope image for Parafilm after MN insertion



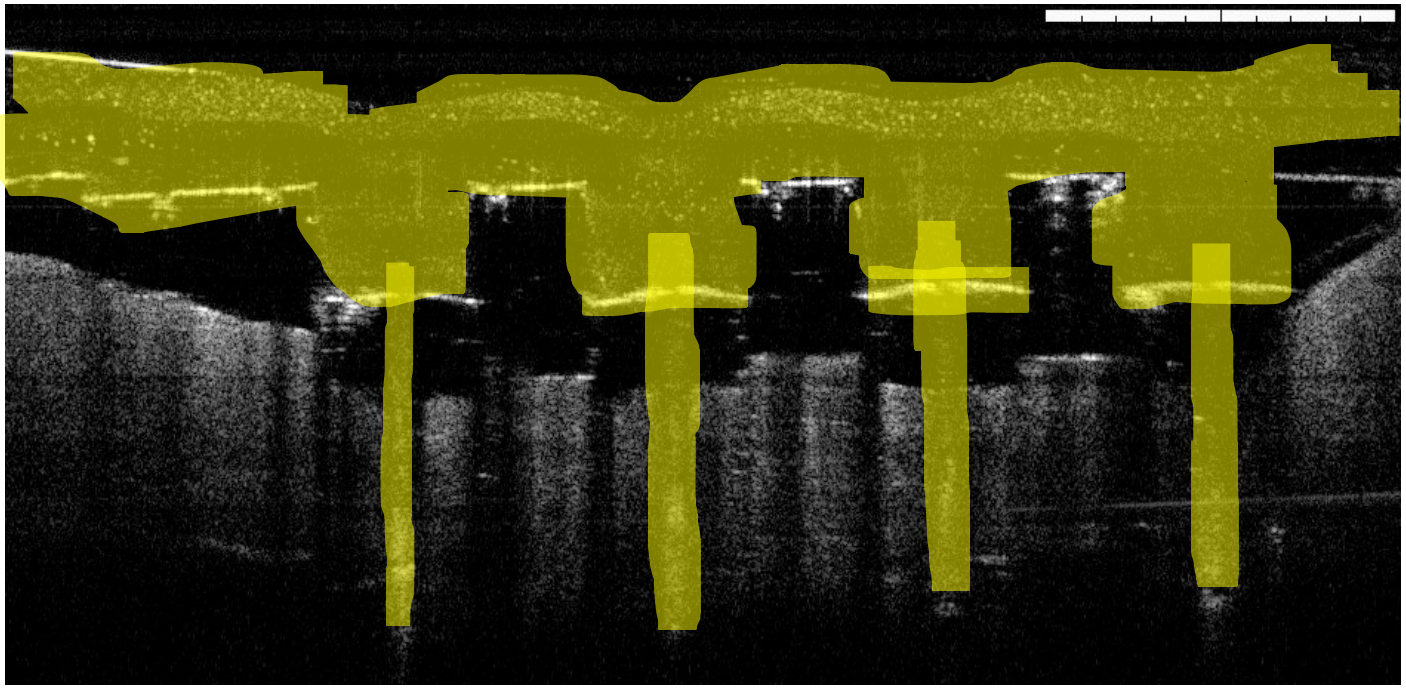
Ref. Eneko Larrañeta, Jessica Moore, Eva M. Vicente-Pérez, Patricia González-Vázquez, Rebecca Lutton, A. David Woolfson, and R.F. Donnelly, *A proposed model membrane and test method for microneedle insertion studies.* International Journal of Pharmaceutics, 2014. **472**(1-2): p. 65-73.

Key Results: B) Cross-shaped hydrogel microneedles

2) Skin insertion test



A light microscope image for MN array inserted to Pig skin



An OCT image for MN array inserted to Pig skin

Conclusion:

- The presented dermal delivery system showed promising potential to overcome the challenges of conventional local photodynamic therapy strategies.
- Hy-LNCs improved both the photodynamic activity and photocytotoxicity.
- The hydrogel MN showed good mechanical properties and was successfully inserted to the skin.
- The crucial next steps are the evaluation of drug content in the LNCs- MN system and skin deposition after MN insertion.

Acknowledgement

- Prof. Ryan Donnelly.
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- Prof. Nawal Khalafallah.
- Dr. Noha Nafee.
- Dr. Alyaa Ramadan.

Alexandria University, Egypt.

Thank you