

STAR particles for enhanced cutaneous delivery of topical therapeutics

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Cutaneous delivery of bioactive agents is important for treatment of many medical indications, especially in dermatology. In this work a novel skin penetration enhancement technology, called STAR particles, was designed, fabricated, developed and characterized *ex vivo* and *in vivo*. STAR particles are millimeter-scale particles with micro-scale projections that painlessly pierce skin to thereby enhance topical drug delivery. STAR particles were fabricated from biocompatible materials (stainless steel and alumina) and applied to skin similarly to conventional formulation-based skin products. STAR particle functionality was demonstrated and characterized through quantification of gentian violet skin staining; skin electrical resistance; and delivery of topically applied compounds (sulforhodamine B, 4 kDa FITC-Dextran, 5-fluorouracil, methotrexate and bleomycin).

After STAR particle pre-treatment, skin electrical resistance decreased by an order of magnitude or greater. Additionally, gentian violet skin staining enabled visualization of the many dozen microscopic skin puncture sites created by STAR particles. STAR particles skin treatment also enhanced cutaneous delivery of molecules by up to 90-fold. The results from these studies demonstrate that STAR particles functioned to increase skin permeability through the formation of microscopic skin punctures. STAR particles were also demonstrated to be safe, tolerable, efficacious and acceptable when applied to skin of healthy human participants. In conclusion, STAR

particles can be used as a formulation-based additive in topical therapies to enhance delivery of topically applied therapies. In this way, STAR particles may potentially improve the clinical potential of topically applied drugs and expand the number of biomolecules that can be administered into skin.