As such, there continues to be a need for the development of new dermal delivery technologies which overcome one or more of the disadvantages experienced with current dermal delivery approaches.

SUMMARY

Dermal delivery compositions are provided. The dermal delivery compositions may include the presence of active agent-calcium phosphate particle complexes, where these complexes include uniform, rigid, spherical nanoporous calcium phosphate particles associated with one or more active agents. Also provided are methods of using the compositions in active agent delivery applications.

In one aspect of the present disclosure, there is provided dermal delivery vehicle particles comprising spherical nanoporous calcium phosphate particles, wherein the particles have an average particle diameter of 0.1~2 microns.

In another aspect of the present disclosure, there is provided the dermal delivery vehicle particles disclosed herein, wherein the particles are produced by:

preparing a fluid composition of calcium phosphate crystals;

drying the fluid composition in a manner sufficient to produce precursor particles; and

sintering the precursor particles at temperature of 200~ 1000°C for 1-10hr to produce the particles.

In a further aspect of the present disclosure, there is provided the dermal delivery vehicle particles disclosed herein, wherein the vehicle is used for a topical formulation.

BRIEF DESCRIPTION OF THE FIGURES

FIGS. 1A to 2B provide scanning electron microscope images of uniform, rigid, spherical, nanoporous calcium phosphate particles that find use in delivery compositions of the invention.

FIG. 3 provides a graphical representation of the particle size distribution of uniform, rigid, spherical, nanoporous calcium phosphate particles that find use in delivery compositions of the invention.

FIG. 4 shows a visual image of active agent attached to calcium phosphate particles.

FIGS. 5A and 5B shows the tape strip images following application of a 10% calcium phospahte particle slurry to the forearm. FIG. 5A shows calcium phosphate particle penetration to the first layer of the stratum corneum. FIG. 5B shows calcium phosphate particle penetration to the third layer of the stratum corneum.

FIG. 6 is an image of mouse skin prior to application of calcium phosphate particles. No Ca^{++} is evident in the upper statum corneum.

FIGS. 7A shows calcium particles in the upper stratum corneum as well as smaller particles in the lower stratum corneum. FIG. 7B shows the loss of integrity of the spherical calcium particles

FIG. 8 is a picture showing penetration of CTC fluorescent throughout the stratum corneum following topical application.

WHAT IS CLAIMED IS:

1. Dermal delivery vehicle particles comprising spherical nanoporous calcium phosphate particles, wherein the particles have an average particle diameter of 0.1~2 microns.

2. The dermal delivery vehicle particles according to Claim 1, wherein the particles have a pore volume ranging from 30 to 85%.

3. The dermal delivery vehicle particles according to Claim 2, wherein the particles have a pore size ranging from 2 nm to 100nm.

4. The dermal delivery vehicle particles according to Claim 1, wherein the particles are produced by:

preparing a fluid composition of calcium phosphate crystals;

drying the fluid composition in a manner sufficient to produce precursor particles; and

sintering the precursor particles at temperature of 200~ 1000°C for 1-10hr to produce the particles.

5. The dermal delivery vehicle particles according to Claim 4, wherein the drying comprises spray-drying.

6. The dermal delivery vehicle particles according to Claim 1, wherein the vehicle is used for a topical formulation.