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KINETIC PARTICLE TYPE I

(1) Expanded perlite unprocessed

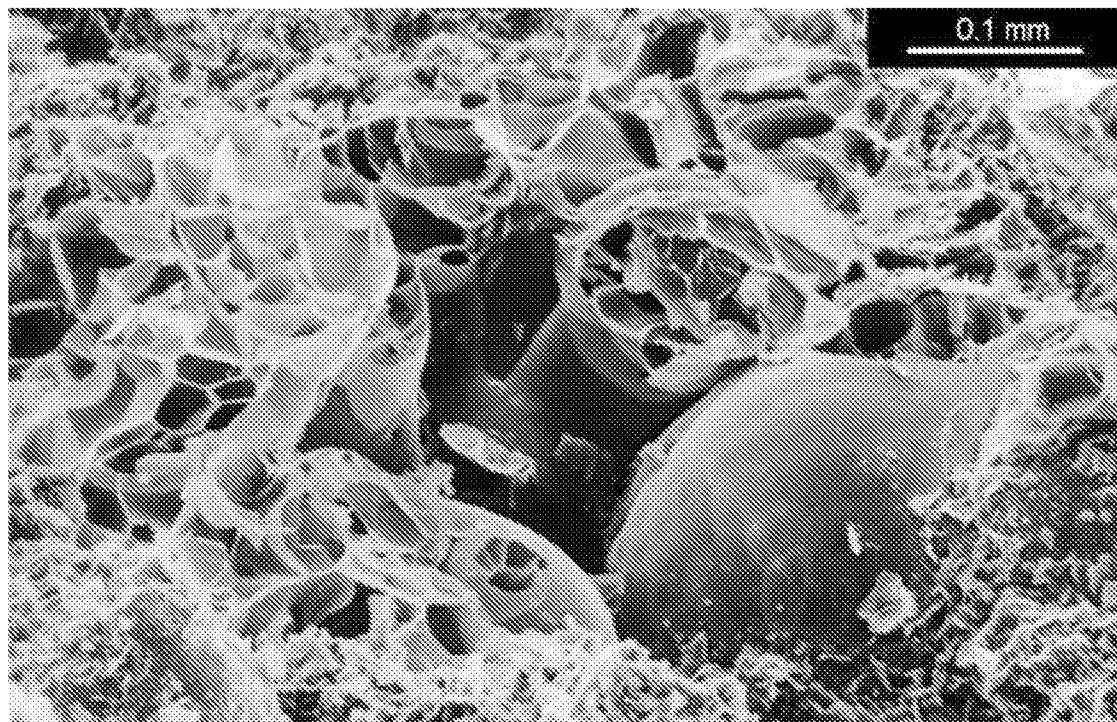
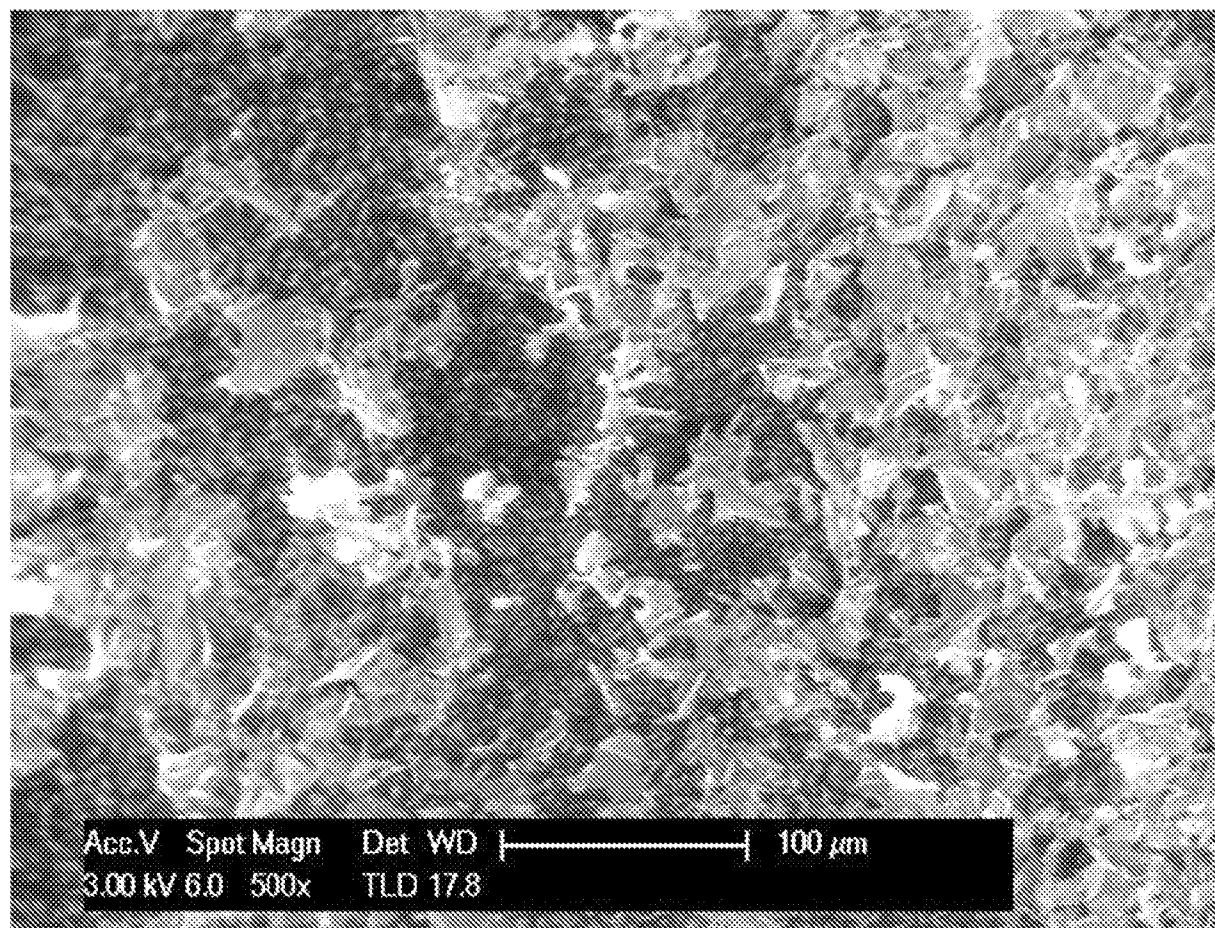


FIG. 1

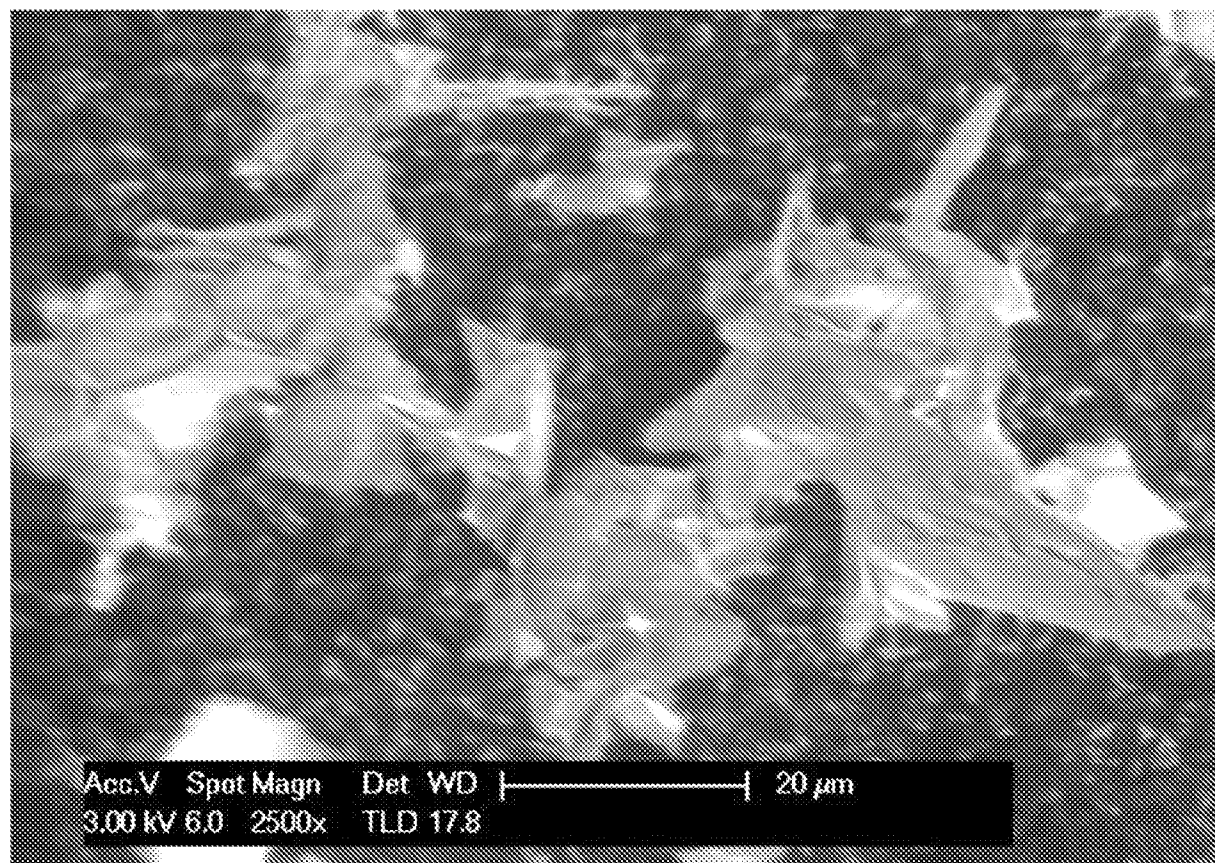
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(2) Processed perlite

*FIG. 2*

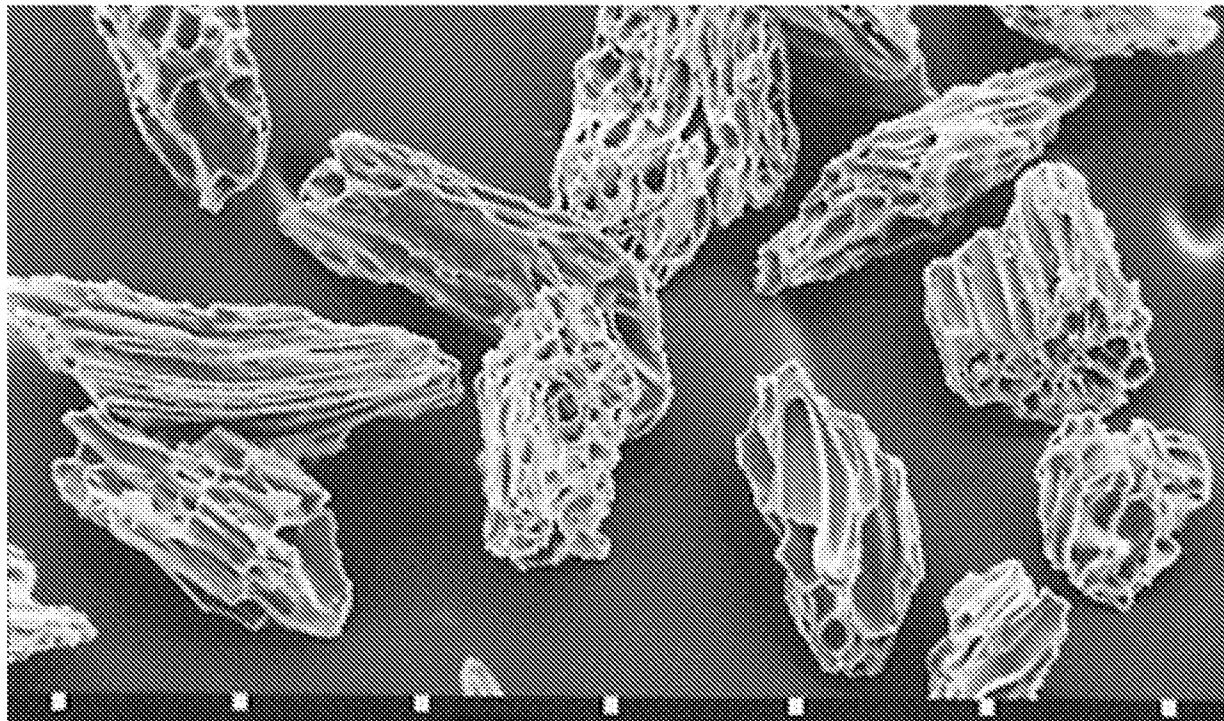
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(3) Processed perlite

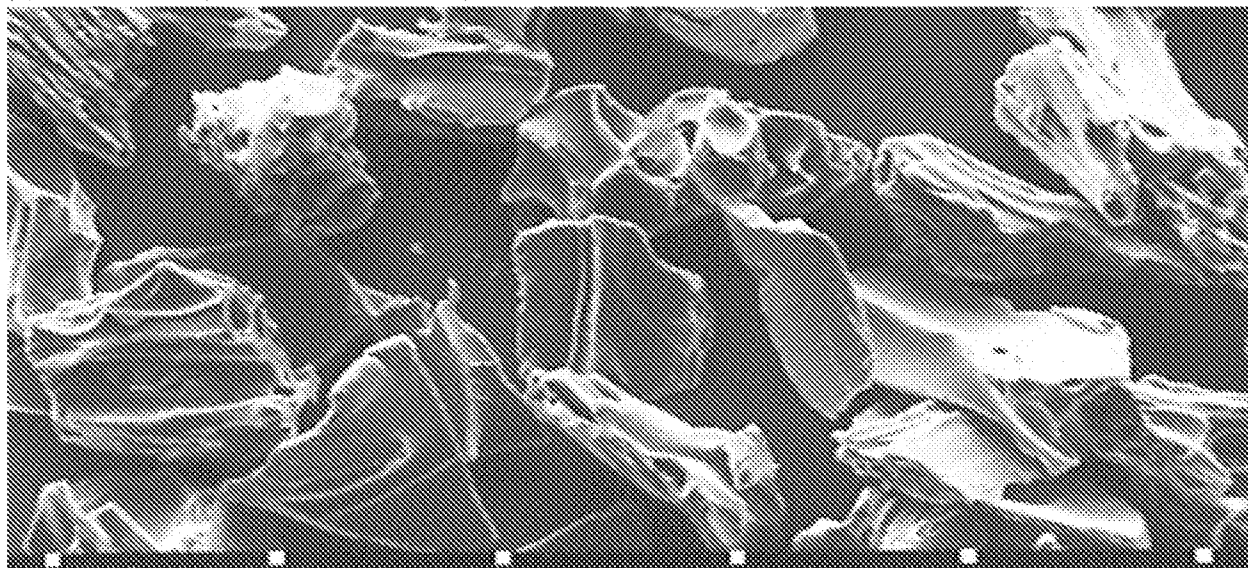
*FIG. 3*

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(4) Volcanic ash (tick mark = 100 micron)

*FIG. 4*

(5) Volcanic ash (tick mark = 50 micron)

*FIG. 5*

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(6) natural zeolite-templated carbon, produced at (A) 700C, (B) 800C, (C) 900C and (D) 1000C

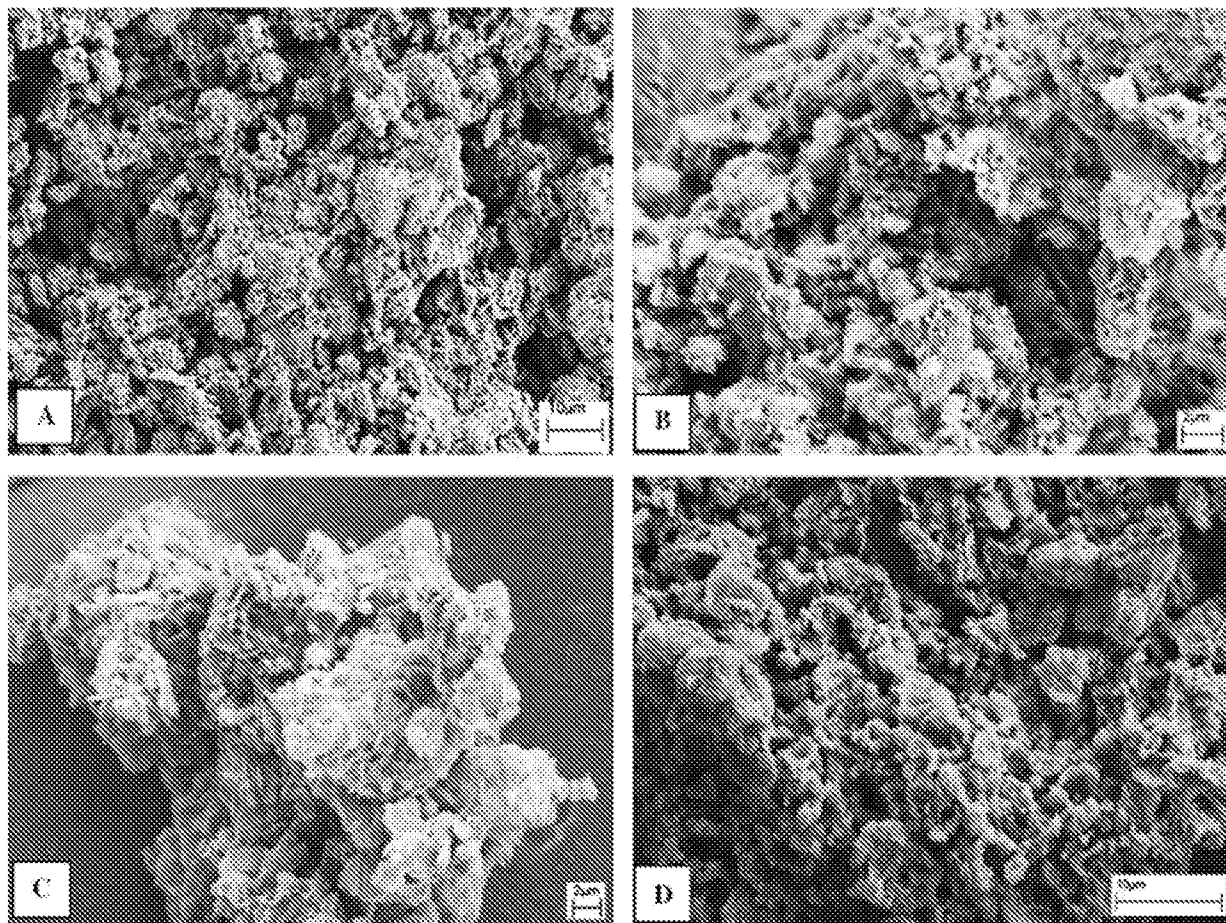
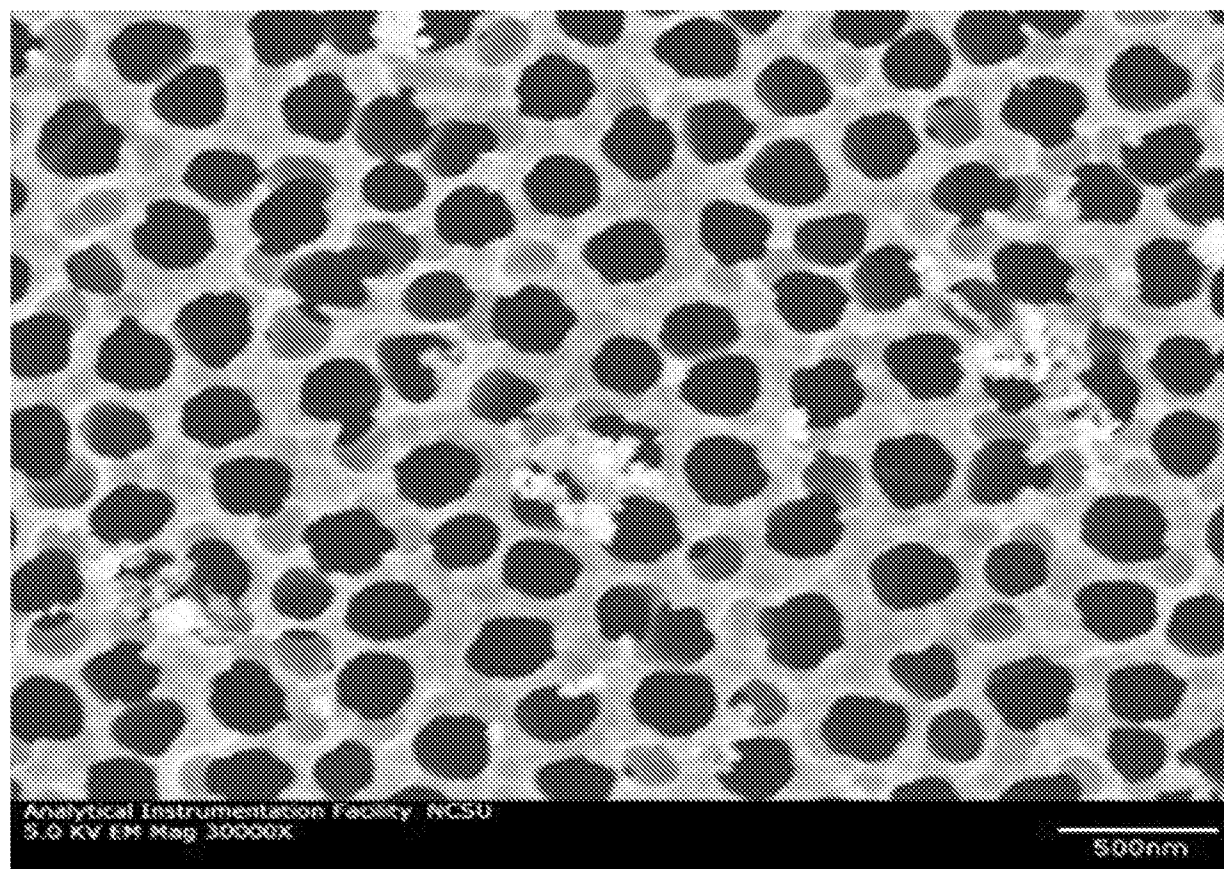


FIG. 6

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(7) nano porous alumina membrane

**FIG. 7**

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(8) Pseudoboehmite phase $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ grown over aluminum alloy AA2024-T3

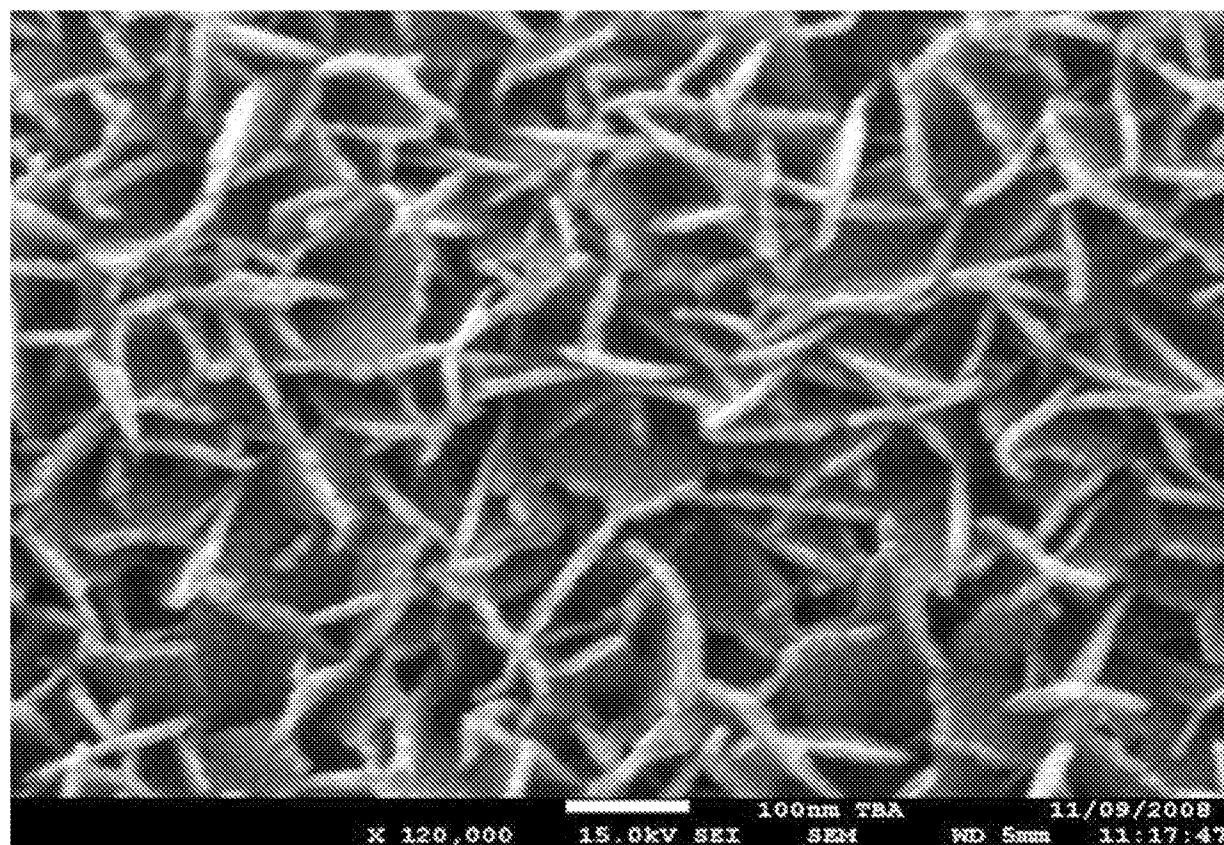


FIG. 8

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KINETIC PARTICLE TYPE II

The majority of hollow spheres materials can undergo a mechanical shaping in order to produce egg shell like fragments with surface characteristics to promote kinetic boundary layer mixing.

(1) Ash hollow spheres unprocessed

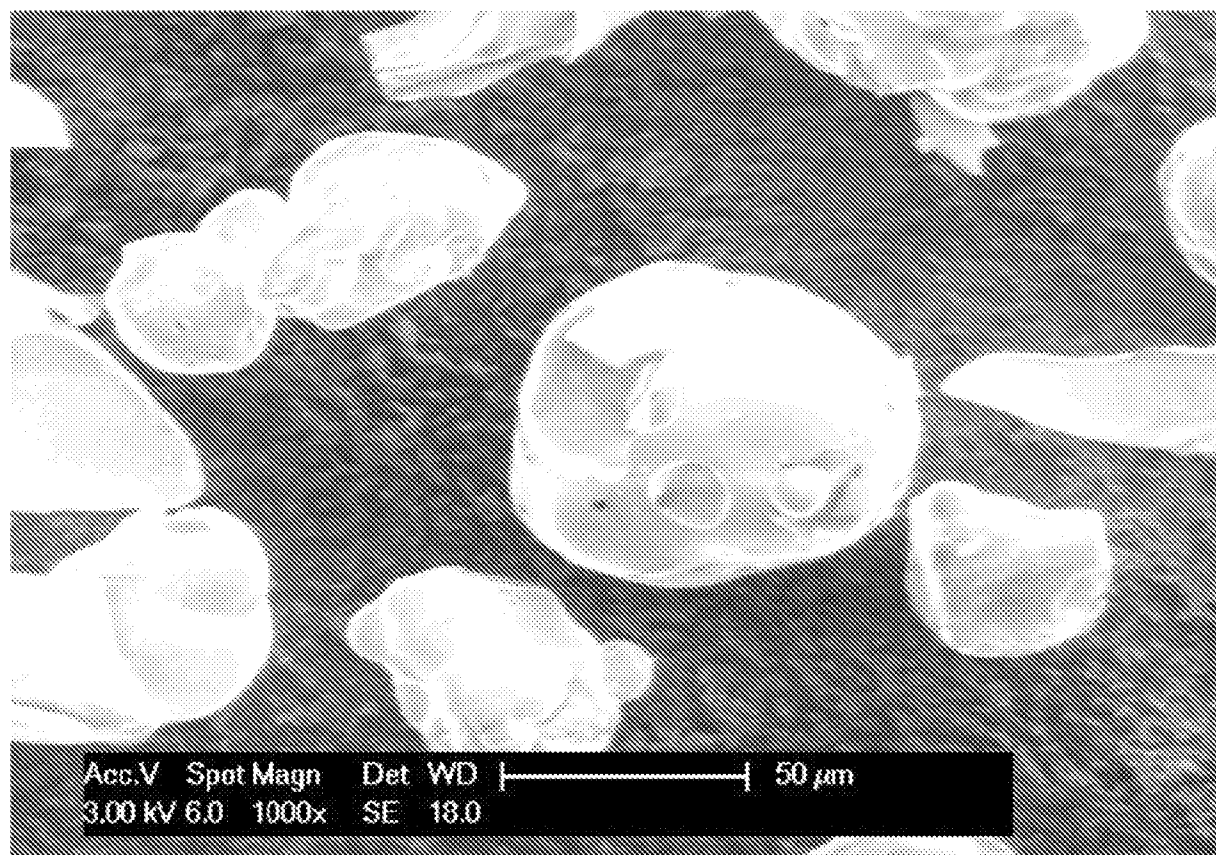
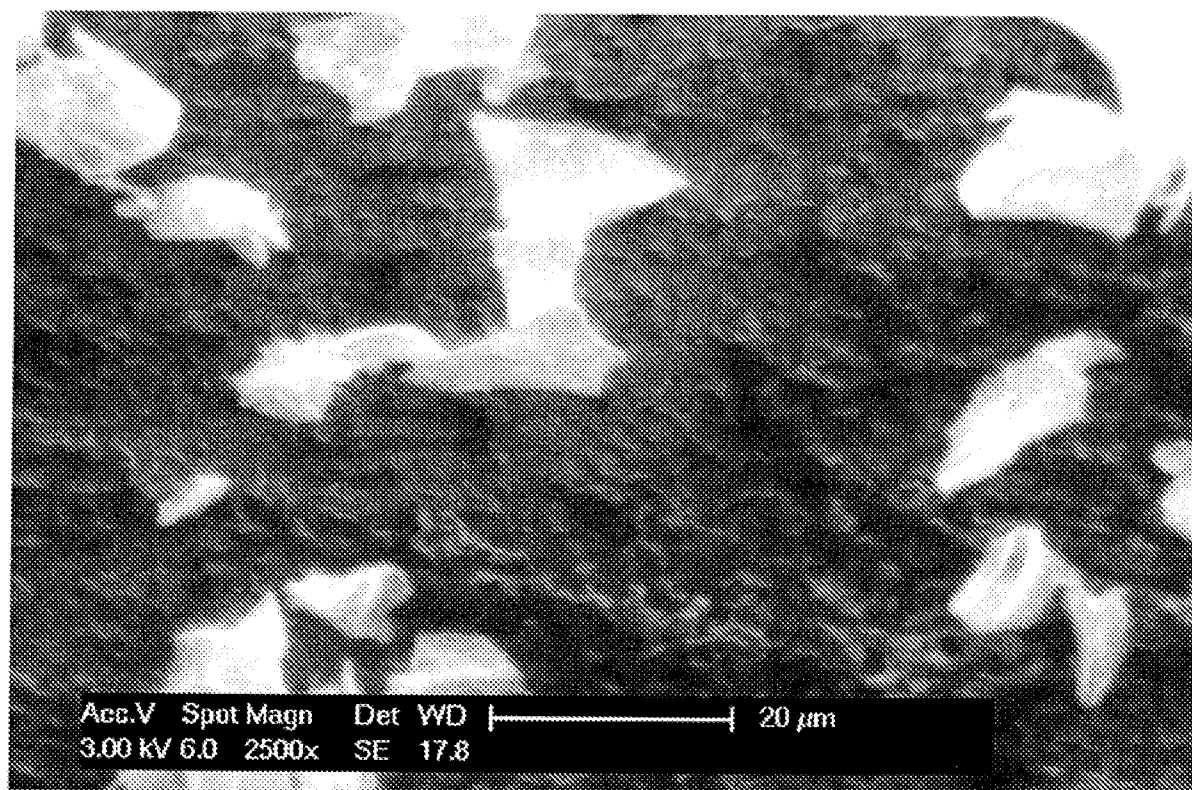


FIG. 9

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(2) Ash 1 hollow spheres processed

*FIG. 10*

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(3) 3M GLASS BUBBLE can be produced into broken eggshell like structures in order to produce surface characteristics to promote kinetic boundary layer mixing.

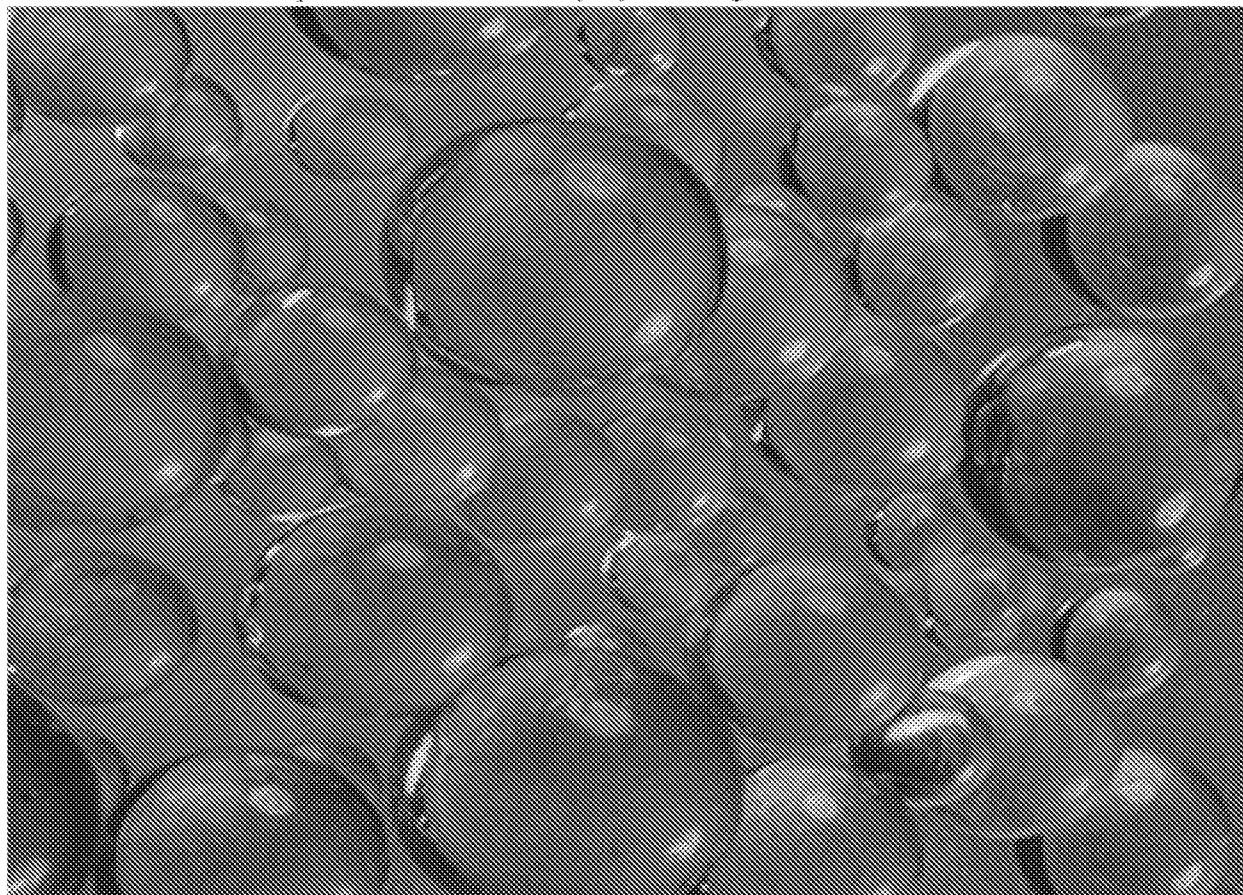


FIG. 11

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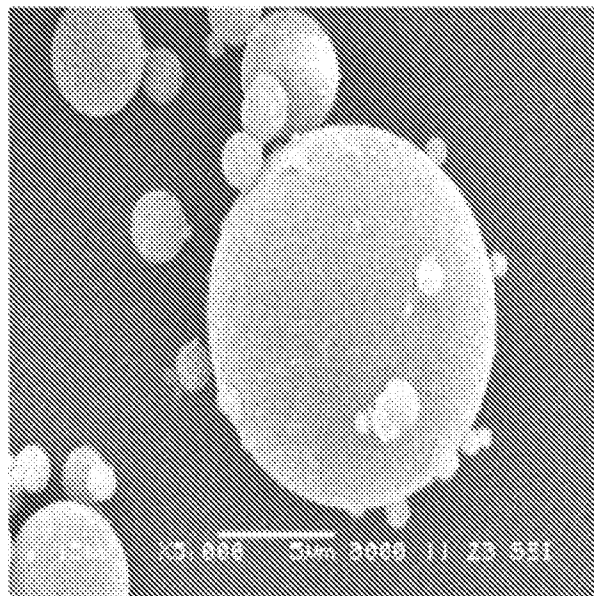


FIG. 12A

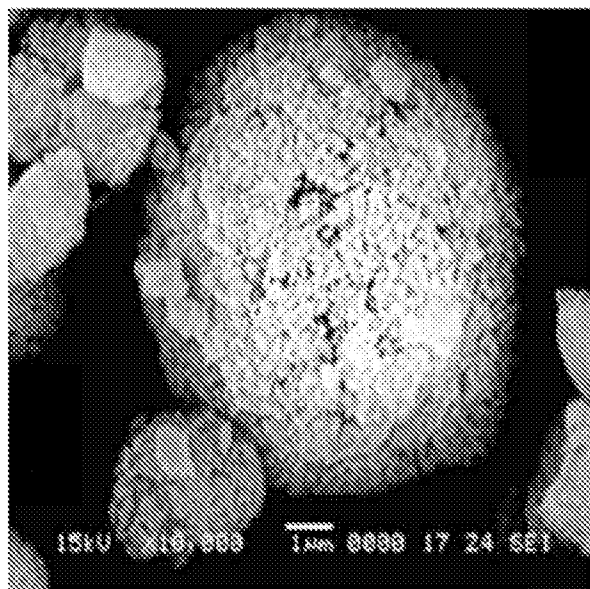


FIG. 12B

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KINETIC PARTICLE TYPE III

Some solid materials have the ability to produce *conchordial* fracturing in order to produce surface characteristics to promote kinetic boundary layer mixing.

(1) Recycled glass 1

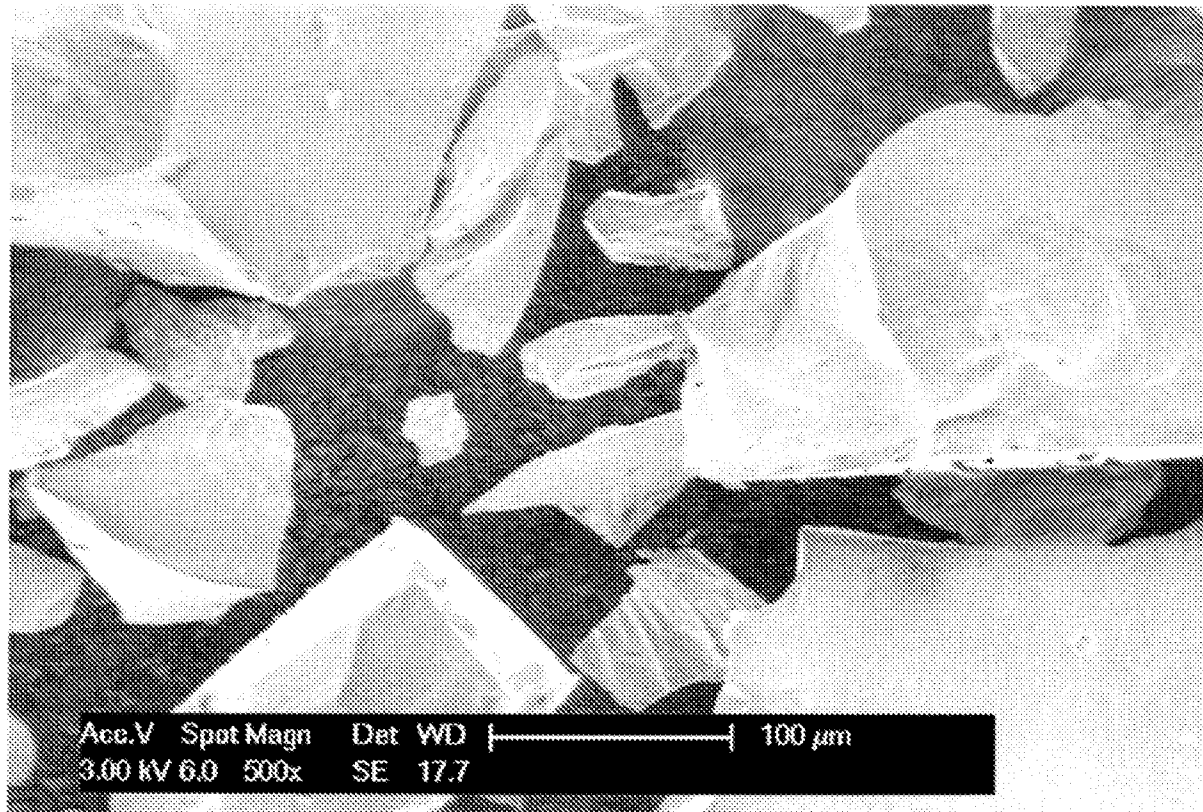
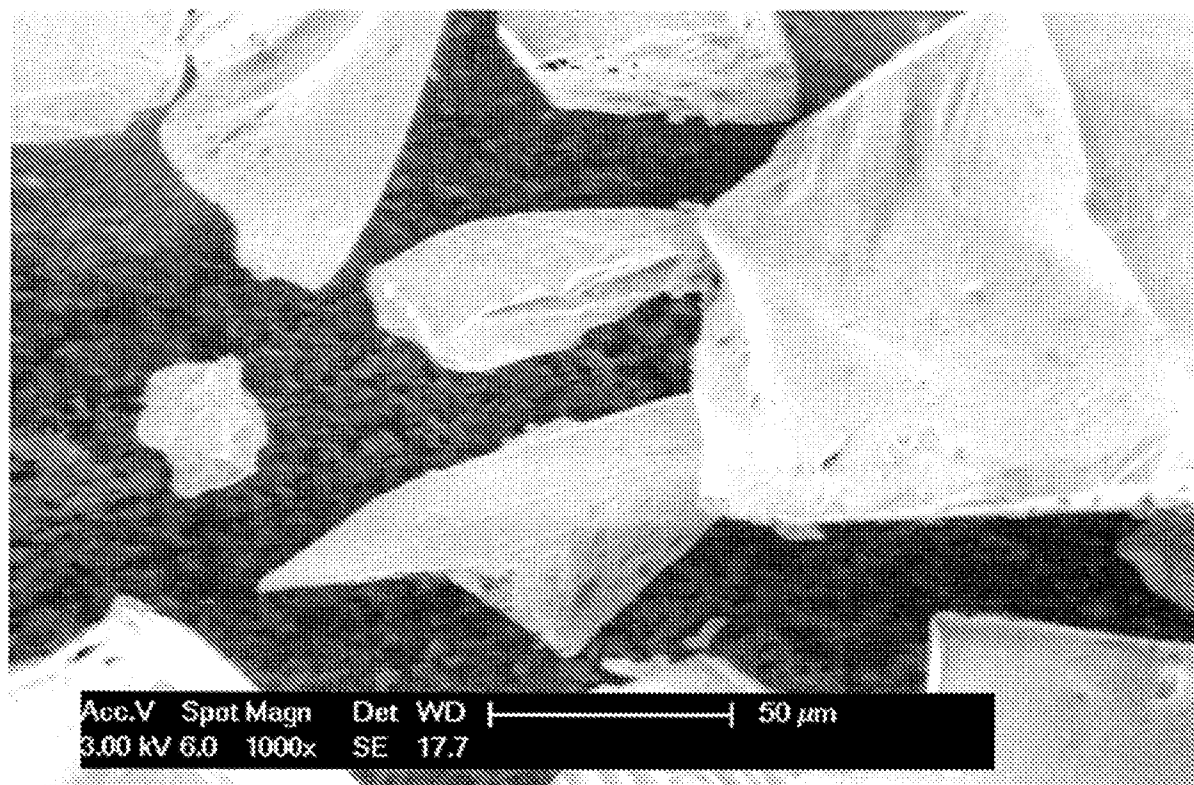


FIG. 13

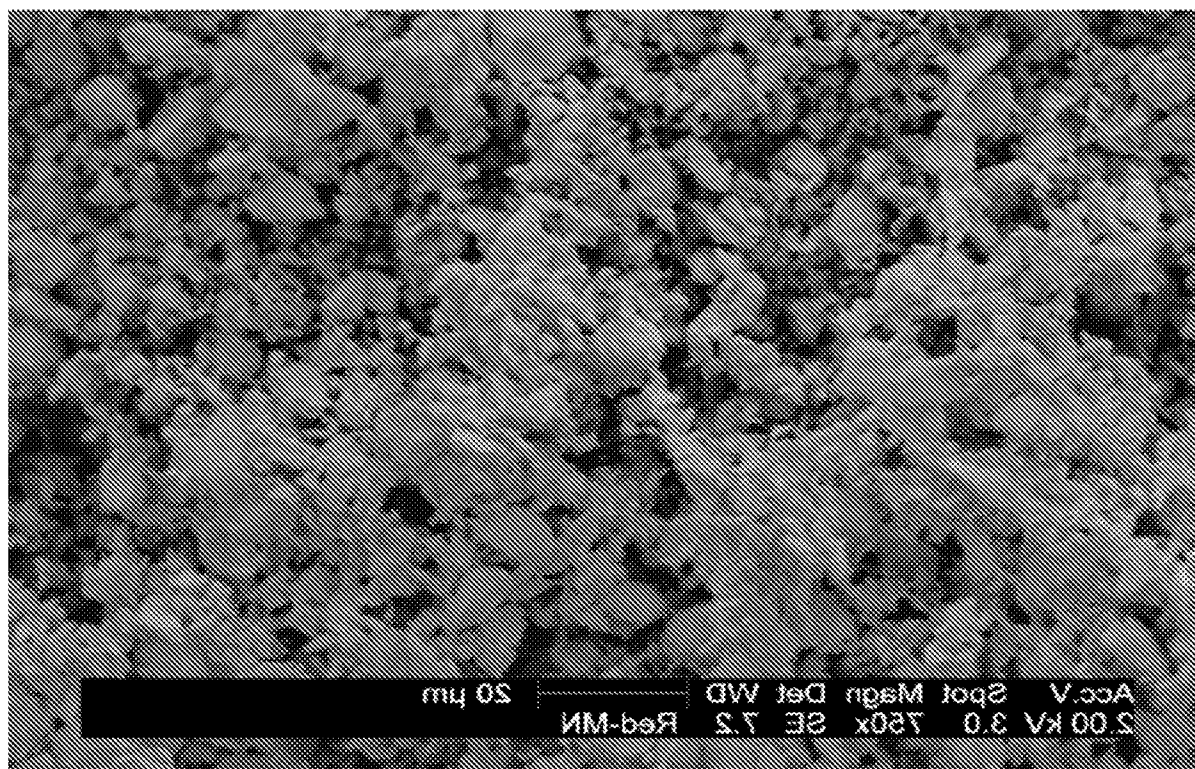
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(1) Recycled glass 2

*FIG. 14*

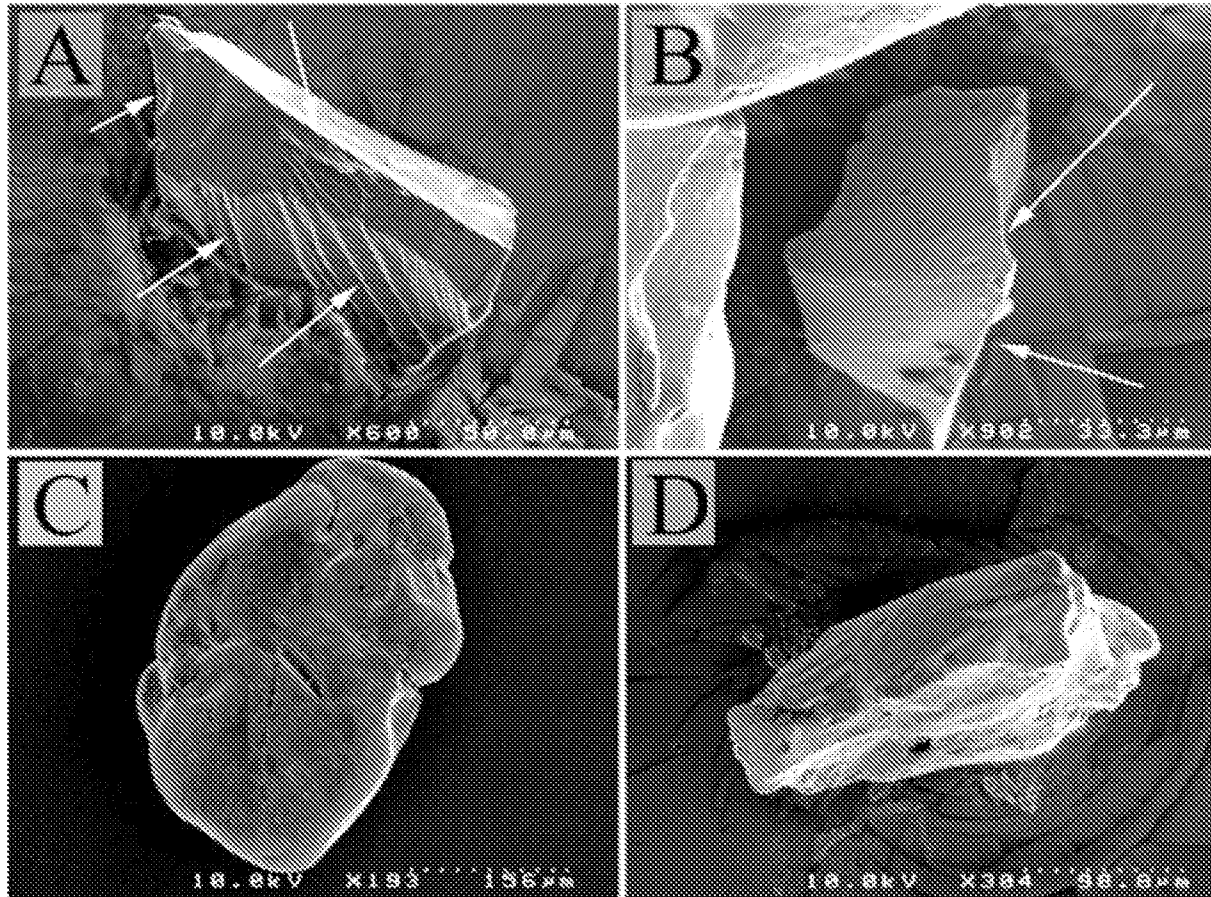
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(3) Volcanic rock (red lava processed)

*FIG. 15*

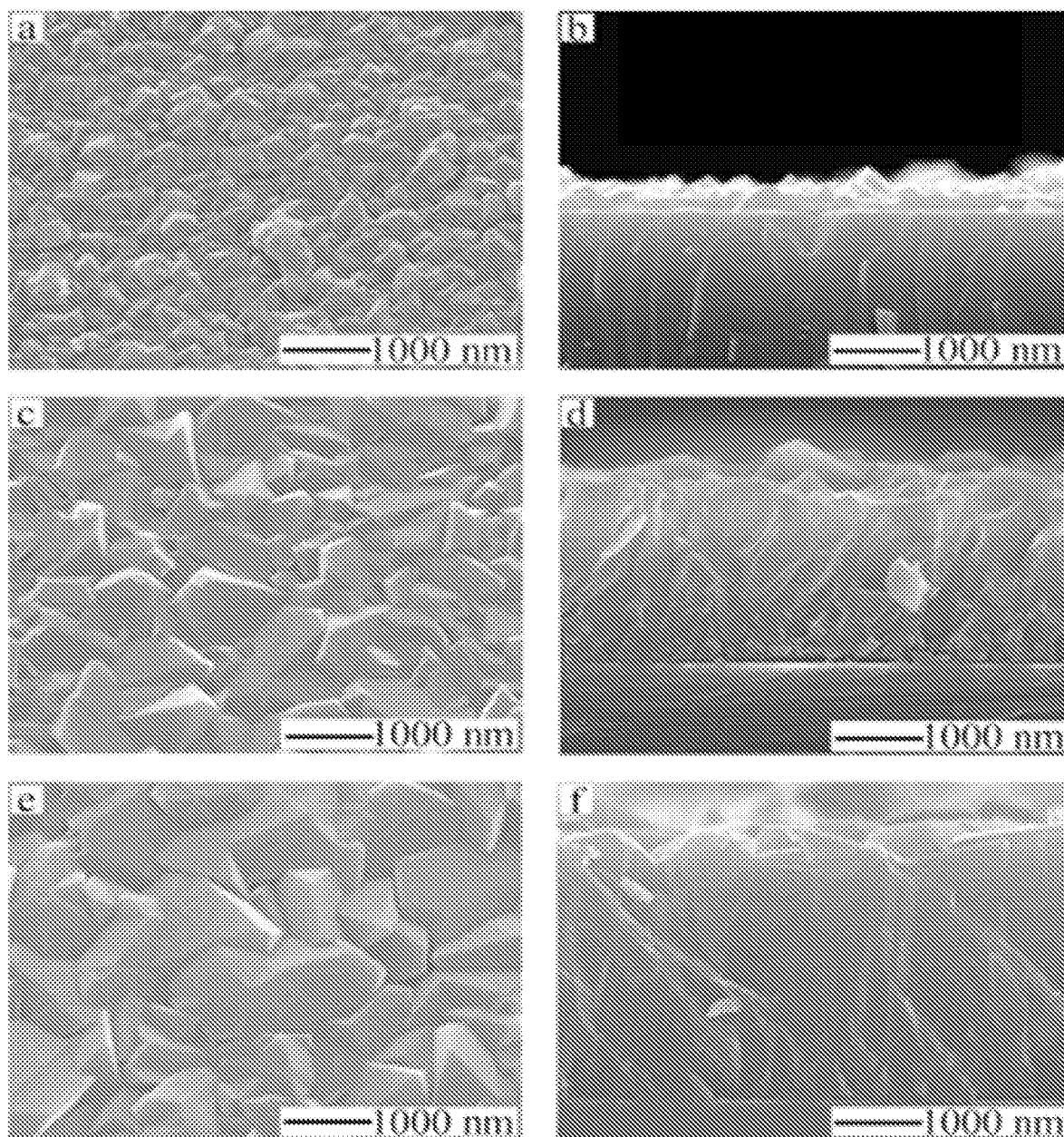
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(4) Images A,B and C are Sand particles that have the ability to fracture, which produces appropriate surface characteristics for kinetic boundary layer mixing particles.

*FIG. 16*

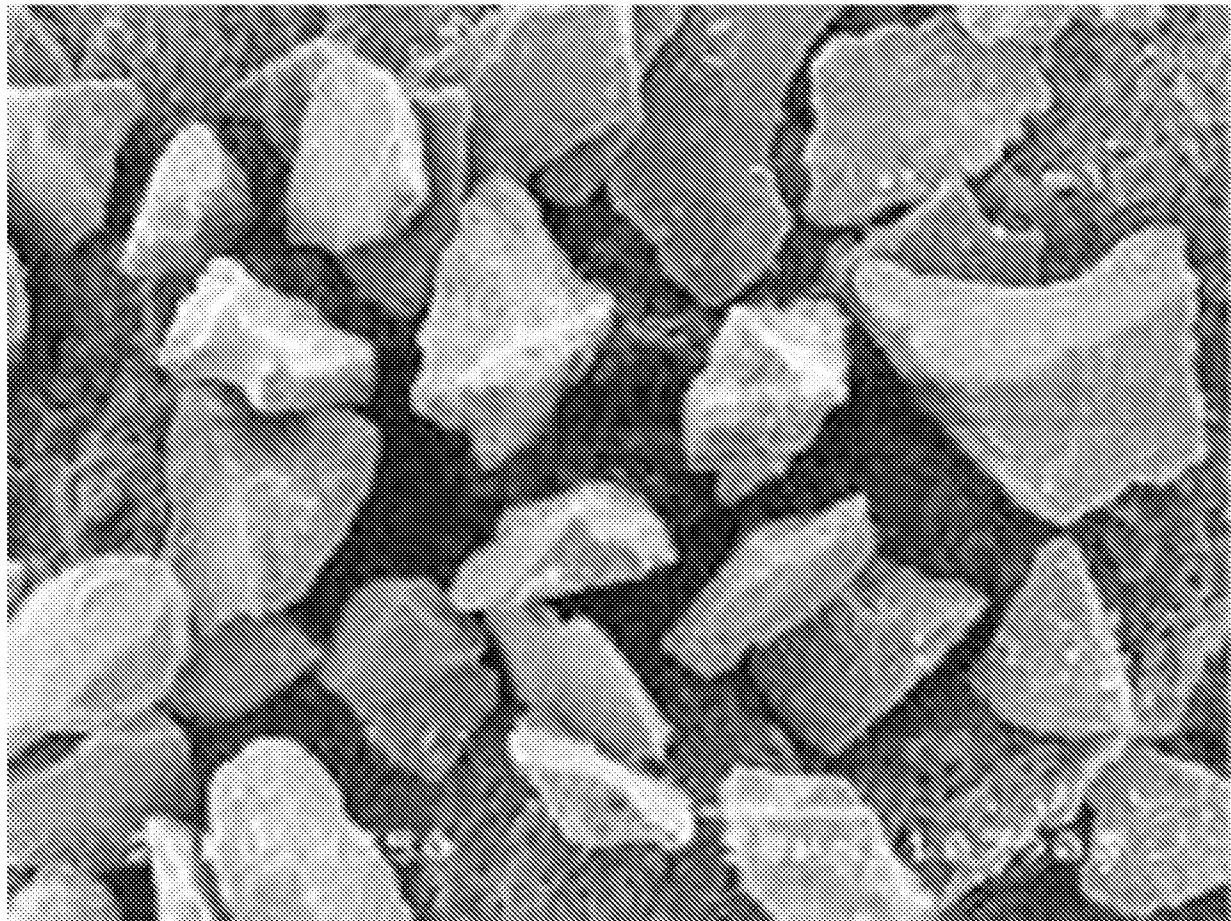
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(5) Zeolite Y, A and Silicate-I

**FIG. 17**

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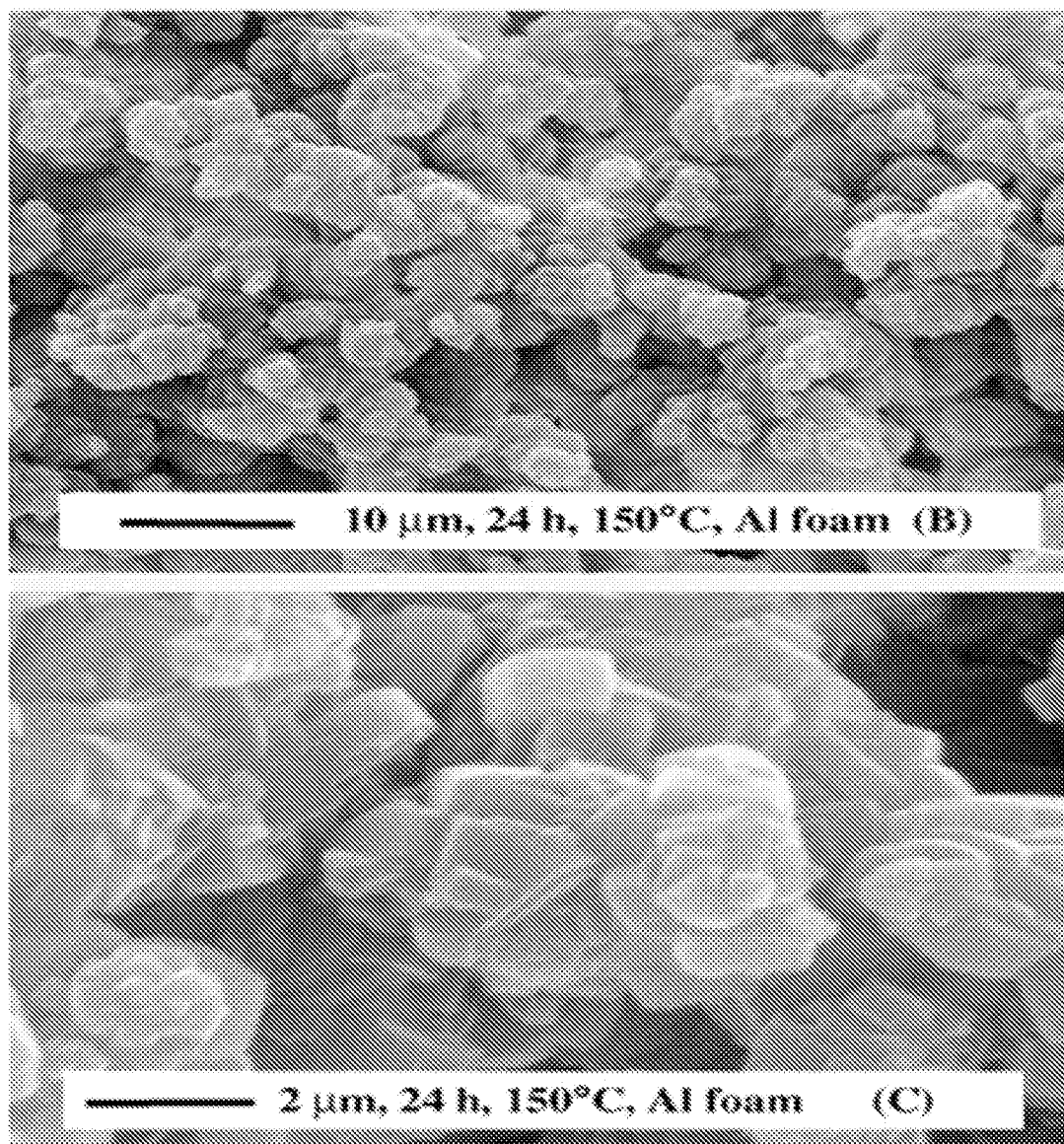
(6) Phosphocalcic hydroxyapatite, formula $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$, forms part of the crystallographic family of apatites, isomorphic compounds with the same hexagonal structure. This is the calcium phosphate compound most commonly used for biomaterial. Hydroxyapatite is mainly used in the medical sector.

*FIG. 18*

*18/34*KINETIC PARTICLE TYPE IV

Some solid clustering materials have the ability to produce fracturing of the cluster structure to produce individual unique uniform materials that produce surface characteristics to promote kinetic boundary layer mixing.

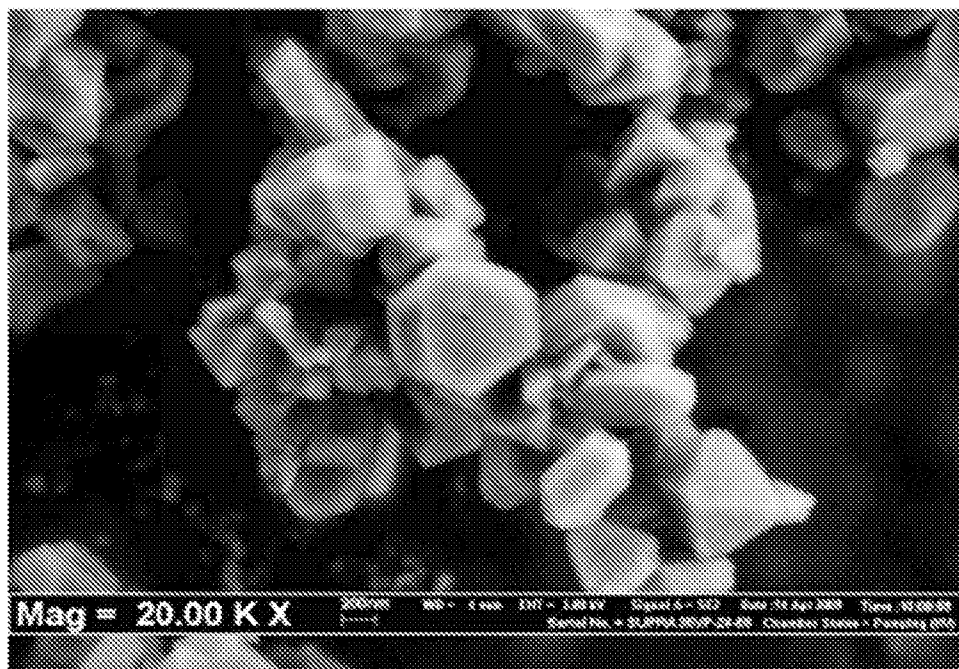
(1)



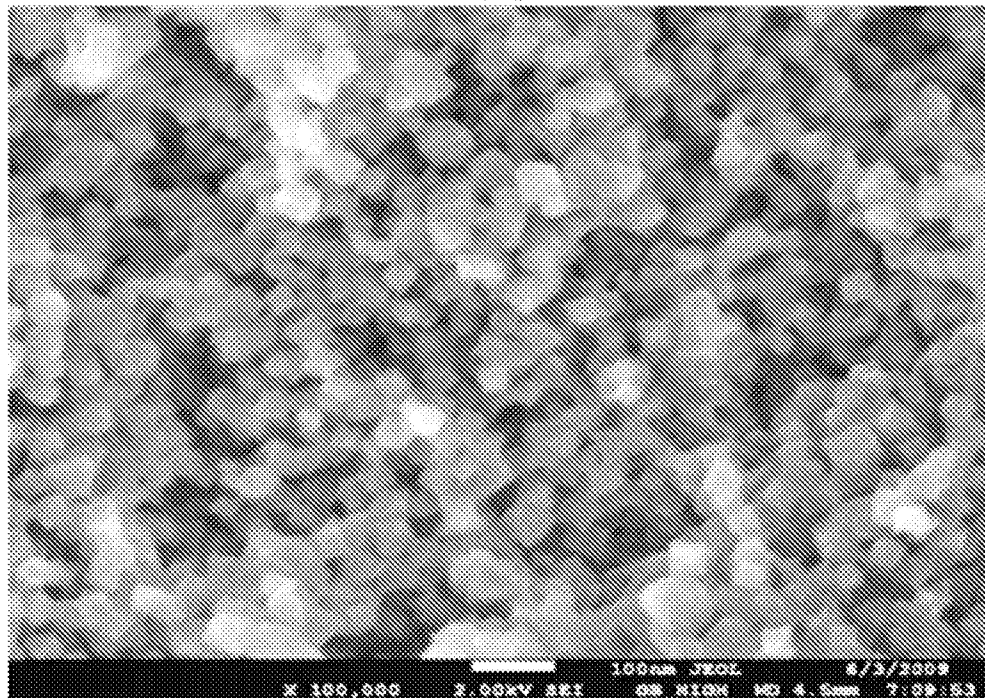
FIGS. 19A, 19B

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(2)



(a)

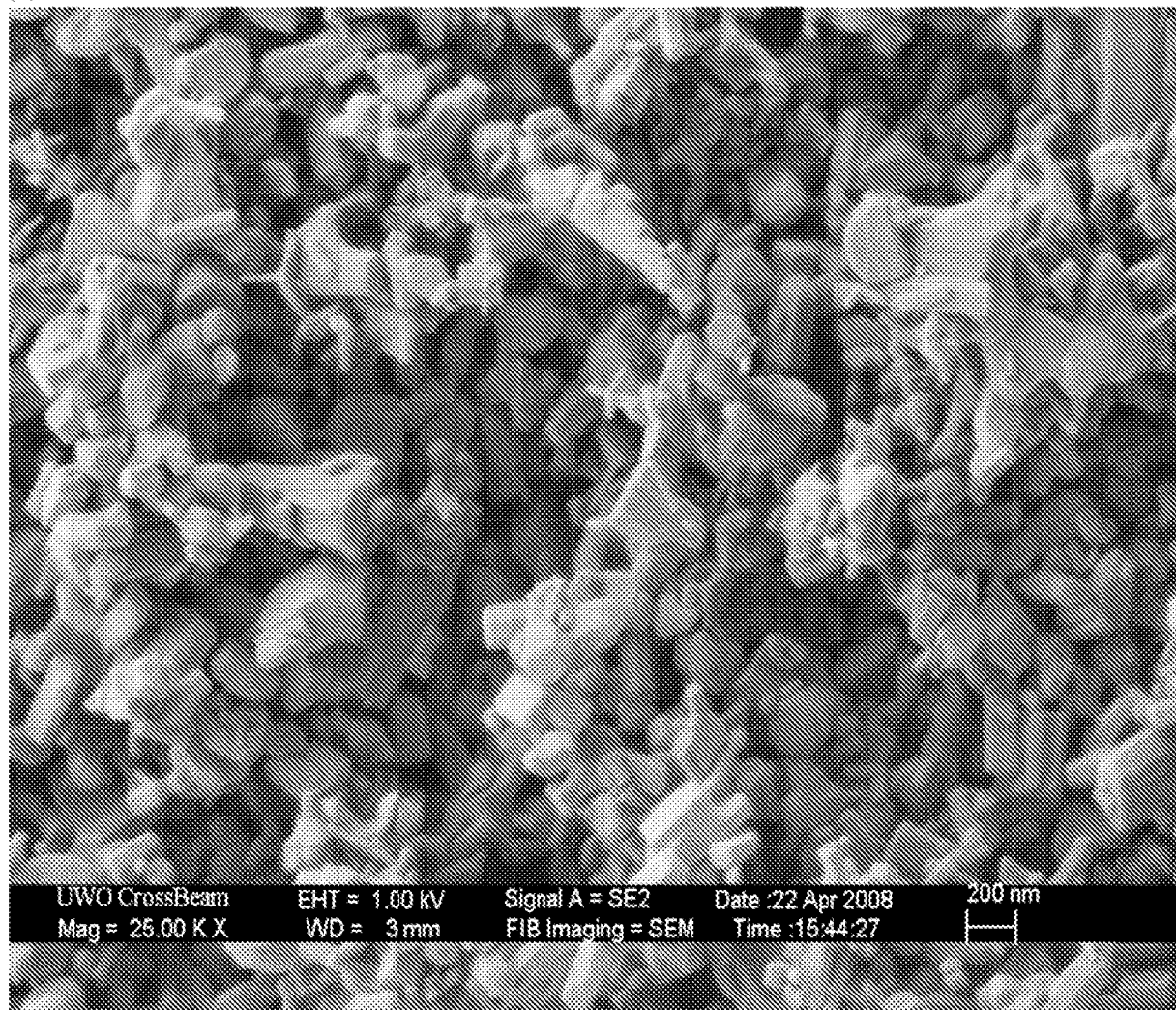


(b)

FIG. 20A, 20B

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(3)



ZnO, 50~150 nm, Hydrophilic

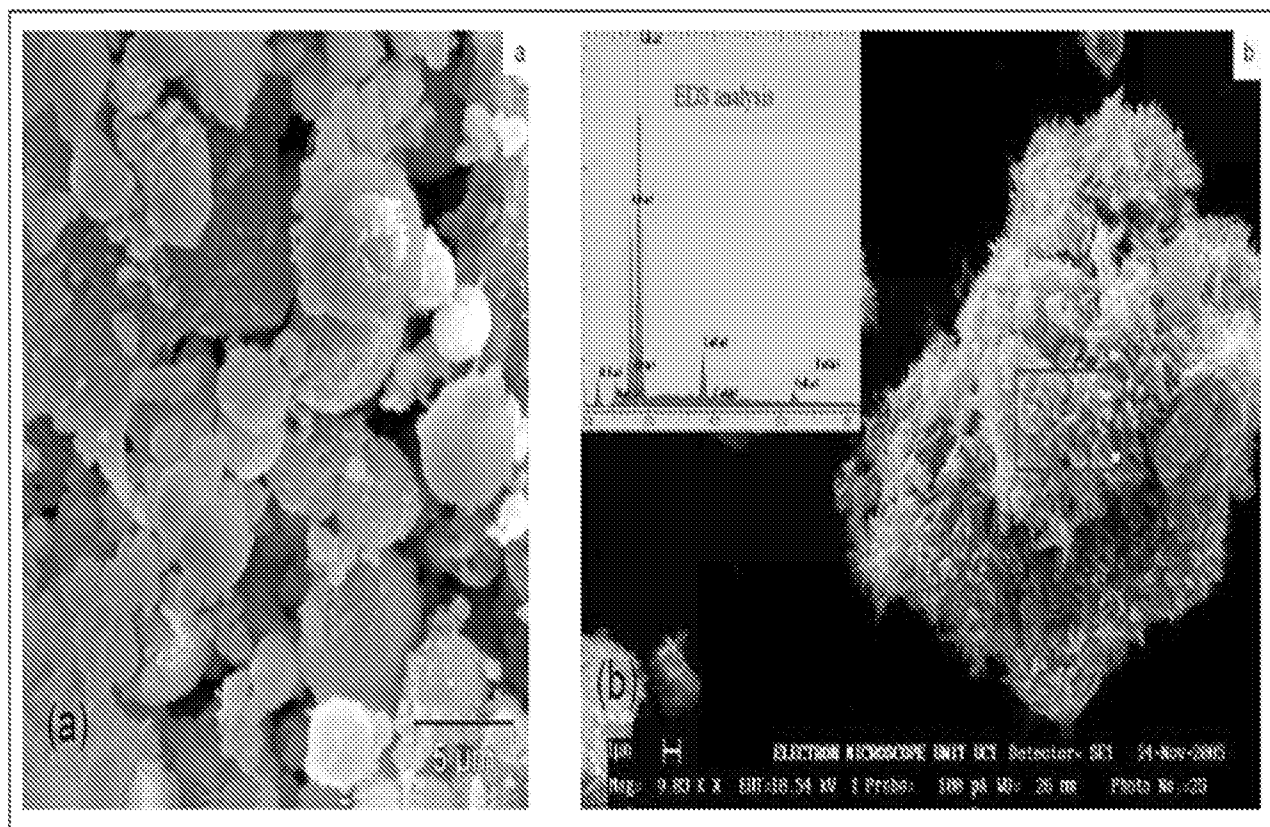
FIG. 21

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KINETIC PARTICLE TYPE V

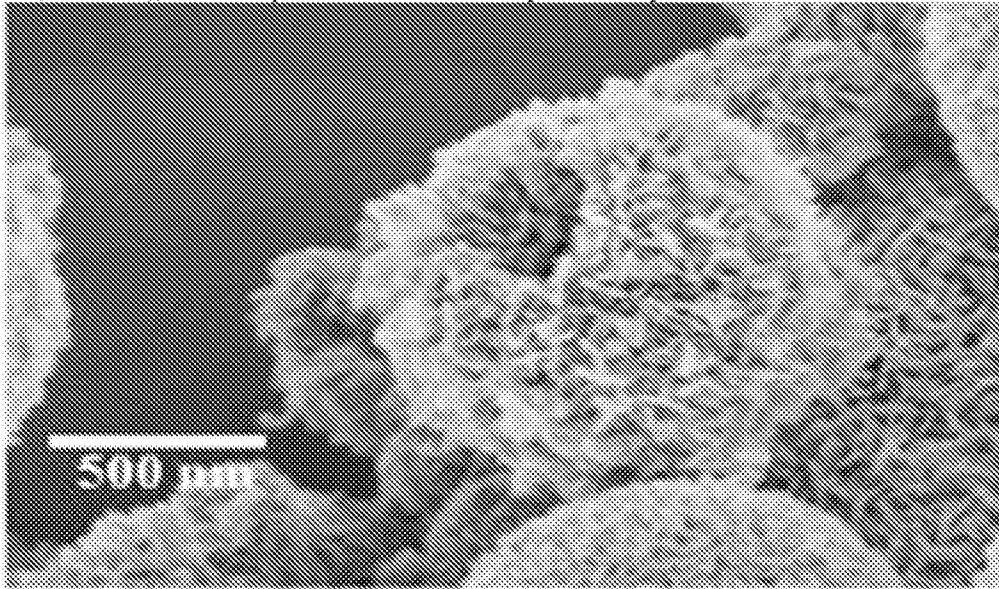
Some hollow or solid semi spherical clustering material with aggressive surface morphology (roughness , groups , striations and hair-like fibers) promote excellent adhesion to the boundary layer with the ability to roll freely and can be used in low viscosity fluids and phase change materials (liquid to a gas and gas to a liquid). They possess the desired surface characteristics to promote boundary layer kinetic mixing.

(1)

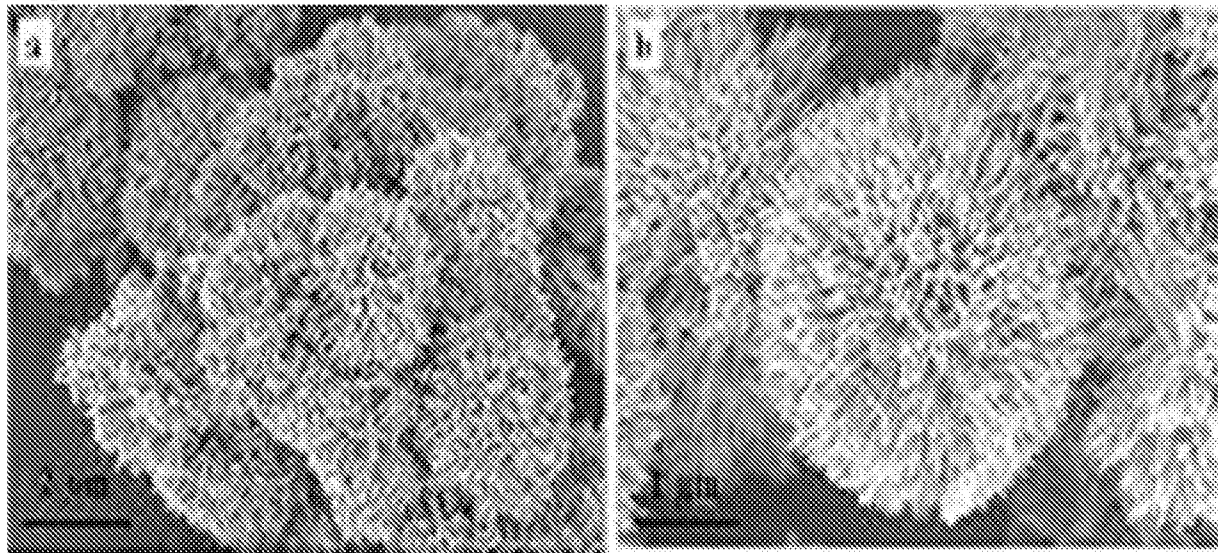
*FIG. 22A**FIG. 22B*

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(2) The nanostructured CoOOH hollow spheres are versatile precursors for various cobalt oxide derivatives (eg. Co_3O_4 , LiCoO_2), and also possess excellent catalytic activity.

*FIG. 23A*

(3) CuO is an important transition metal oxide with a narrow bandgap (E_g) 1.2 eV). CuO has been used as a catalyst, a gas sensor, in anode materials for Li ion batteries. CuO has also been used to prepare high temperature superconductors and magnetoresistance materials

*FIG. 23B**FIG. 23C*

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(4) Figure C has naturally formed rough surfaced spheres

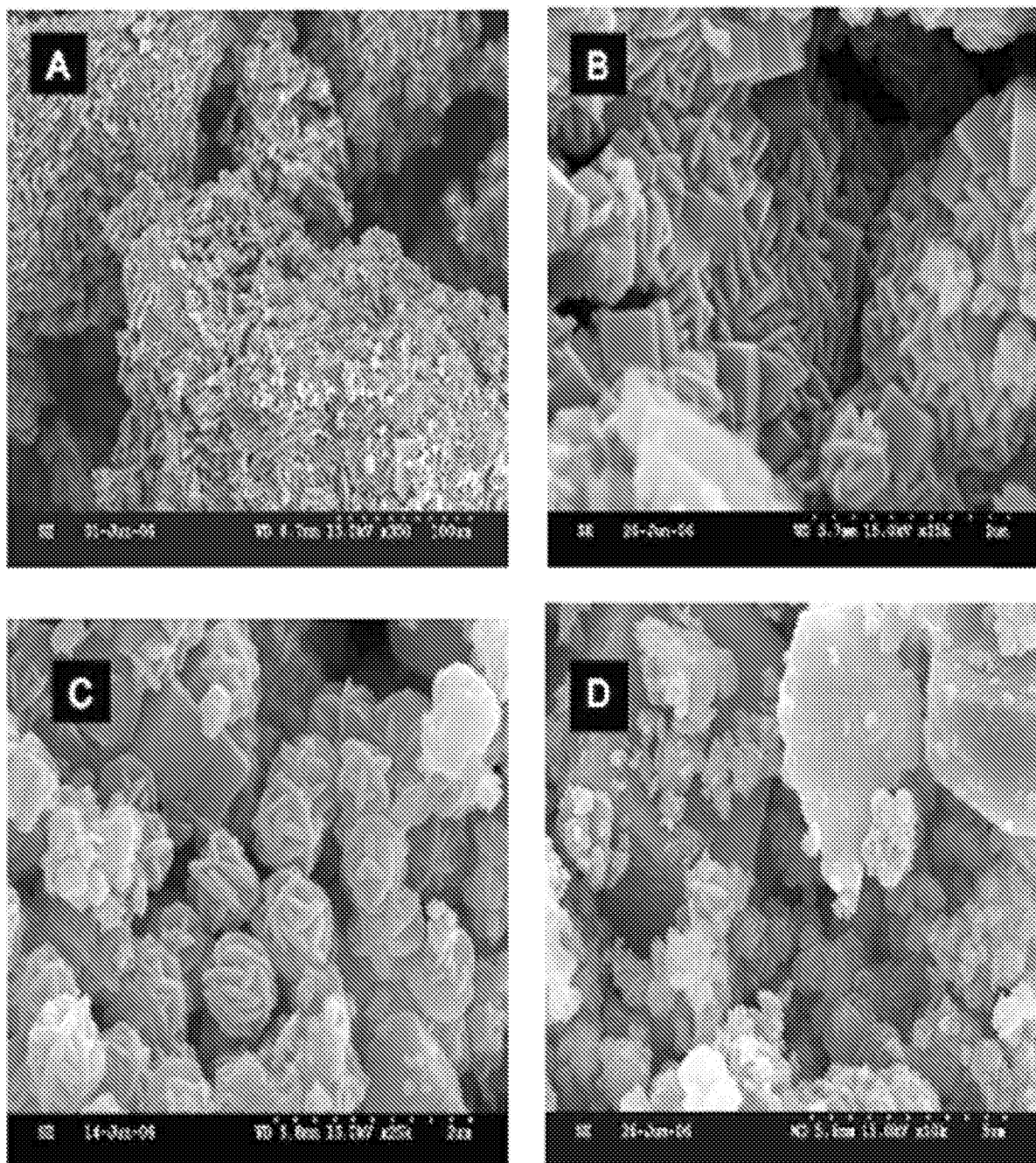


FIG. 24A, 24B, 24C, 24D

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(5) 2.5 μm uniform plain Al_2O_3 nanospheres

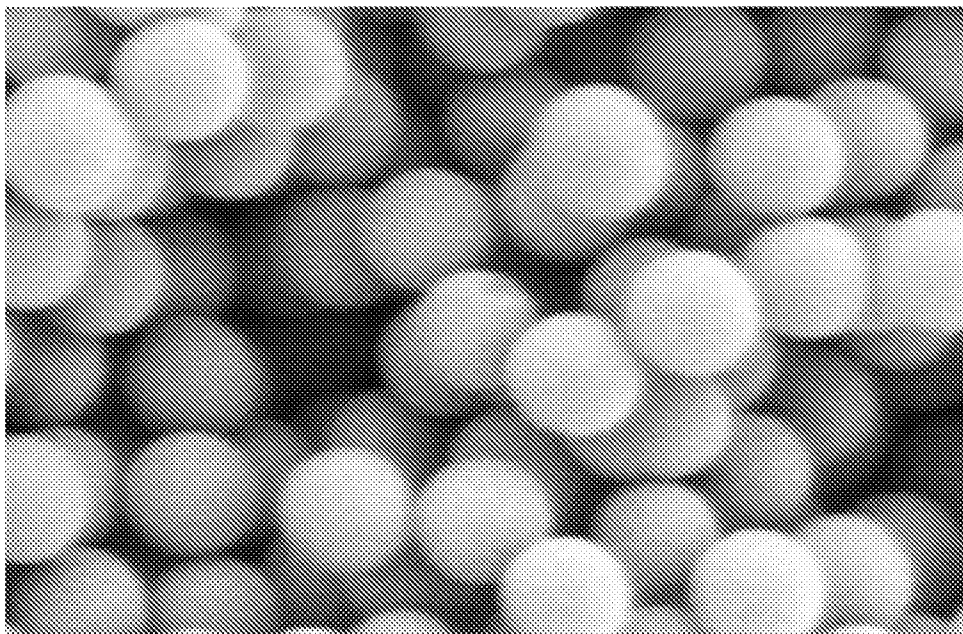


FIG. 25A

(6) 635 nm uniform plain Al_2O_3 nanospheres (have hair-like fibers on the surface)

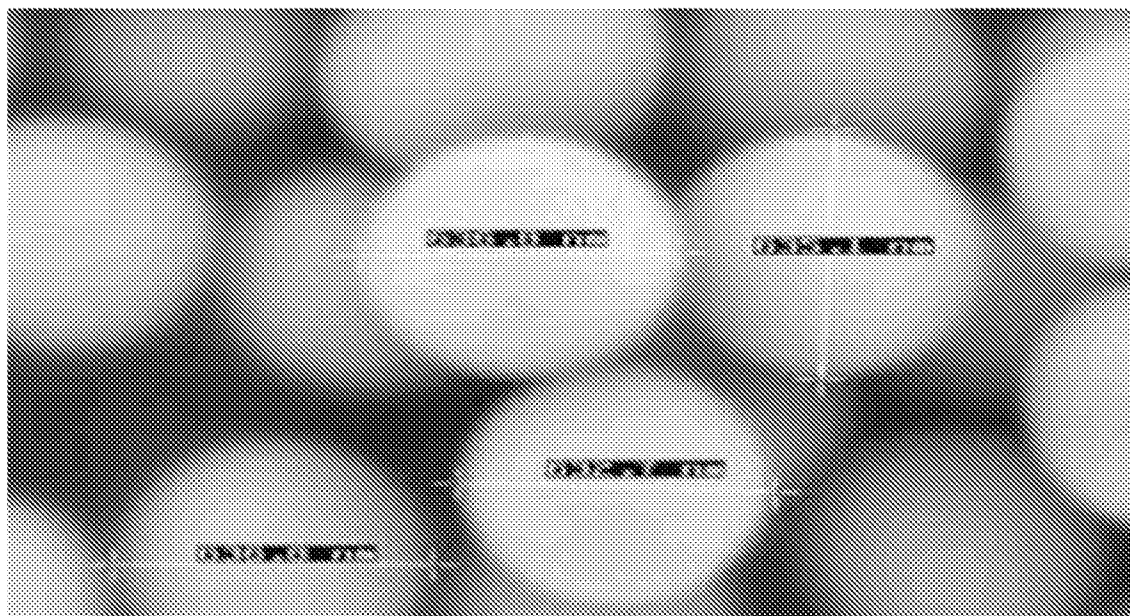
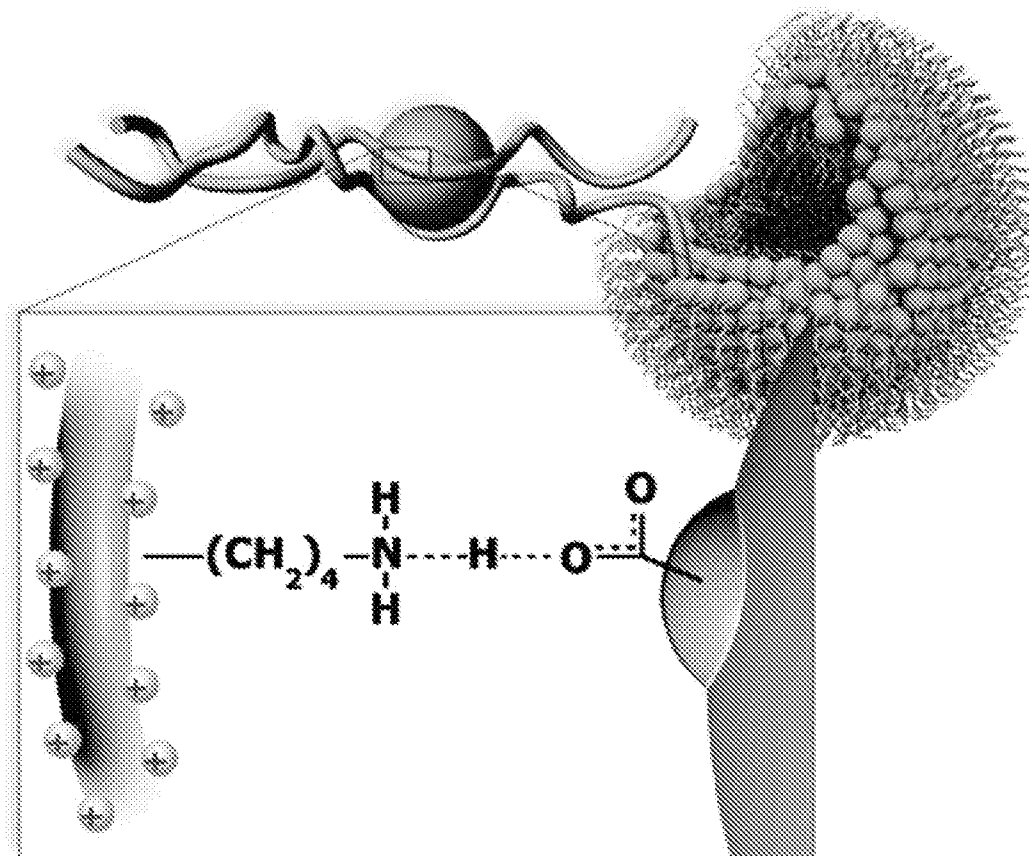


FIG. 25B

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(7) This computer generated model shows hair-like fibers which promote boundary layer adhesion so that nano sized particles will stay in contact with the boundary layer while rolling along it producing kinetic mixing.



J. N. Cha, H. Birkedal, M. H. Bartl, M. S. Wong and G. D. Stucky, "Spontaneous Formation of Nanoparticle Vesicles from Homopolymer Polyelectrolytes," *J. Am. Chem. Soc.* 125, 8285-8289 (2003).
DOI: [10.1021/ja0279601](https://doi.org/10.1021/ja0279601)

FIG. 26

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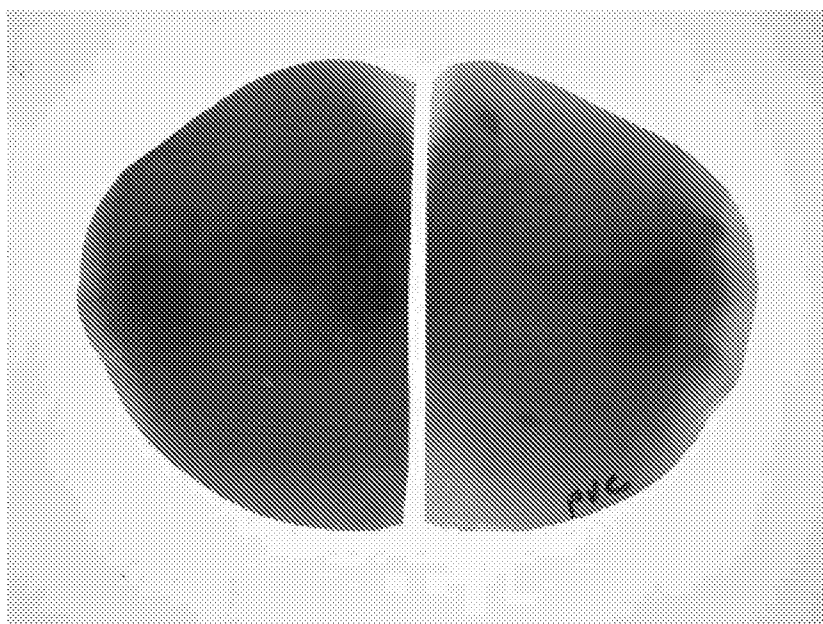


FIG. 27

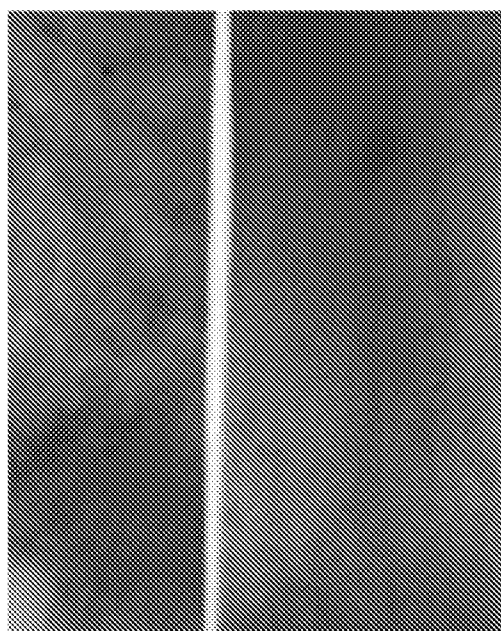


FIG. 28

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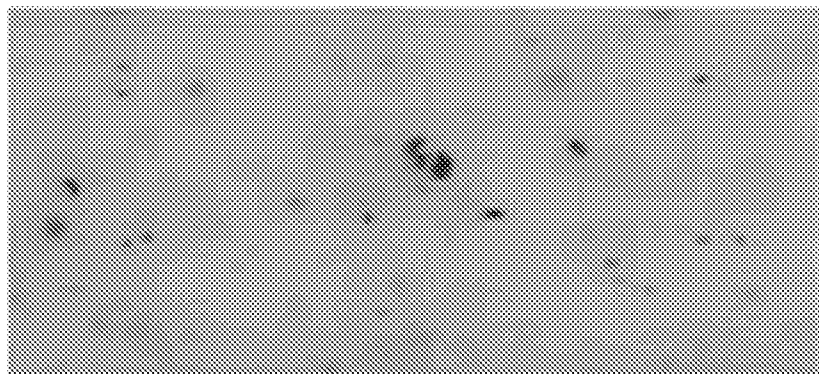


FIG. 29



FIG. 30

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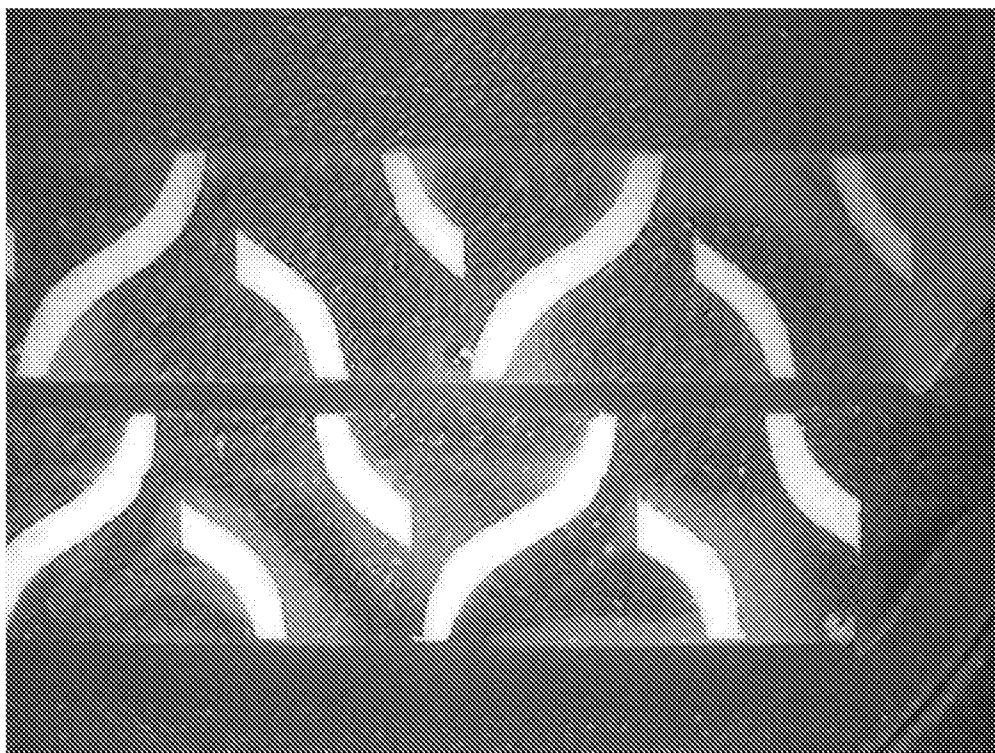
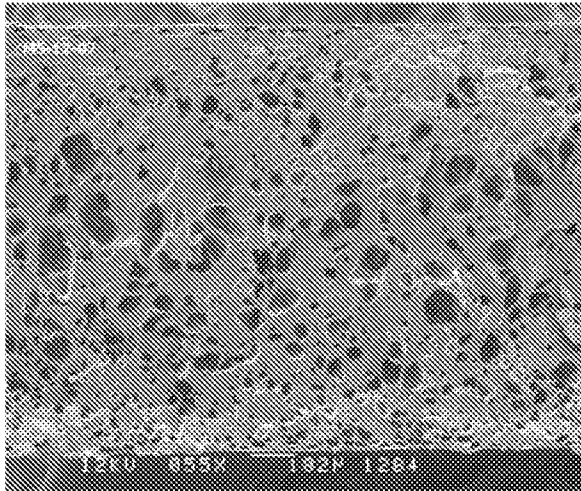
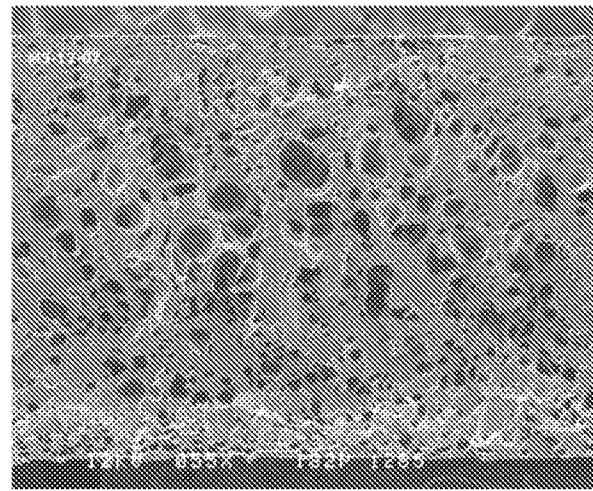
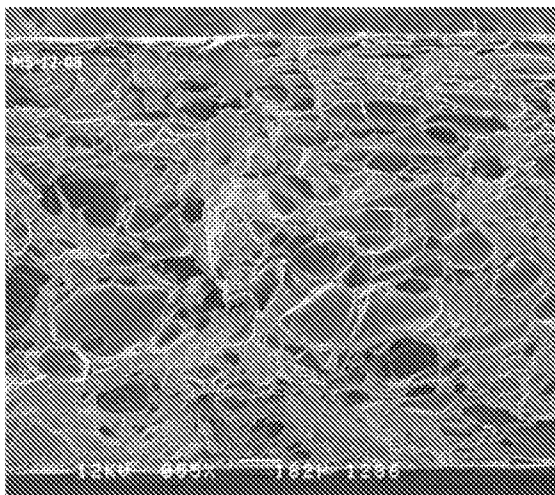


FIG. 31

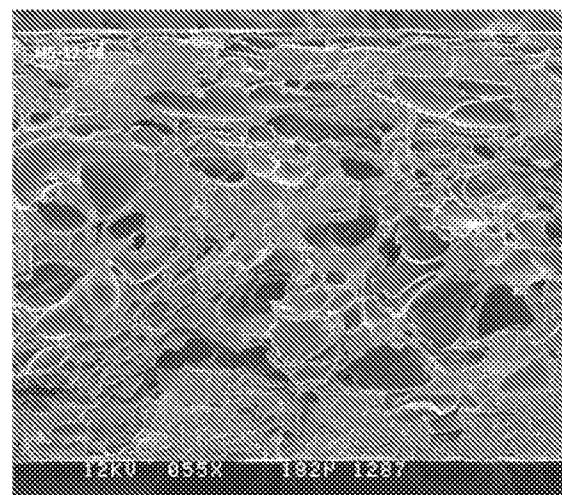
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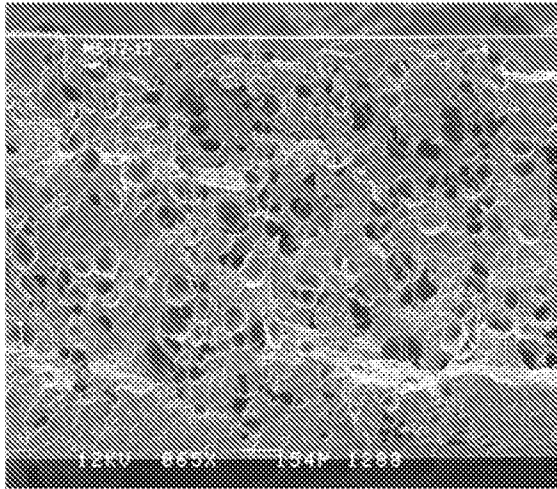
High Impact Polystyrene HC 80634-HIPS
8 melt index; 1.05 wt% kinetic mixing particle;
P = 0,77 g/cc, 46 μ

FIG. 32A**FIG. 32B**

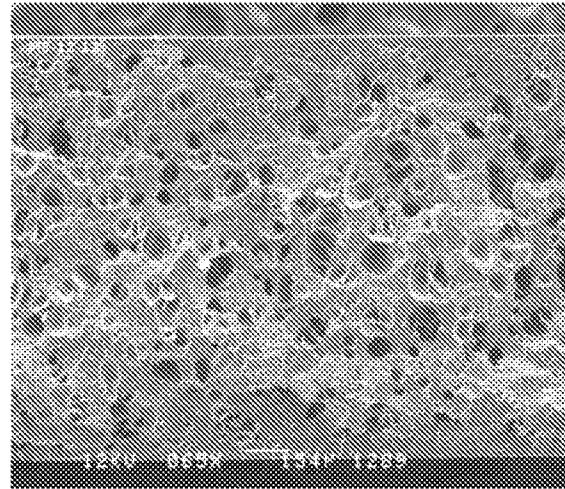
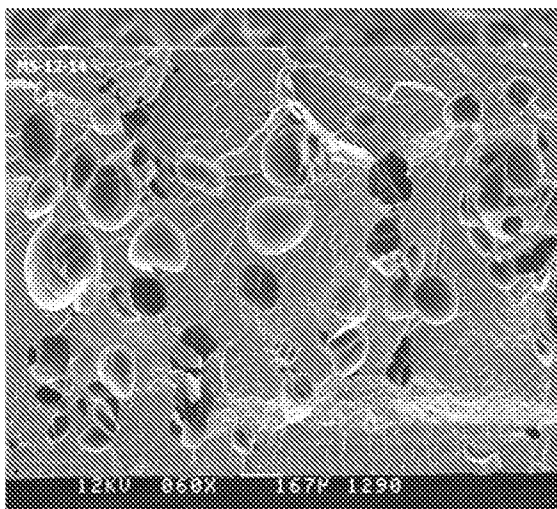
High Impact Polystyrene HC 80634-HIPS
8 melt index; 0.35 wt% kinetic mixing particle;
P = 0,74 g/cc, 217 μ

FIG. 32C**FIG. 32D**

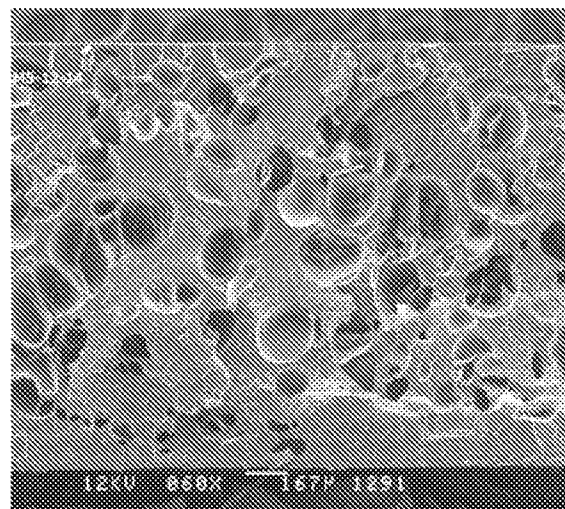
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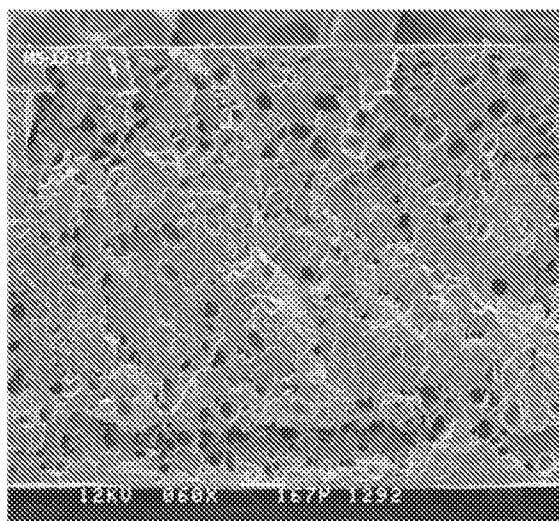
Polypropylene PC 90635-PP
12 melt index; 1.2 wt% kinetic mixing particle;
P = 0,69 g/.cc, 77 μ

FIG. 32E**FIG. 32F**

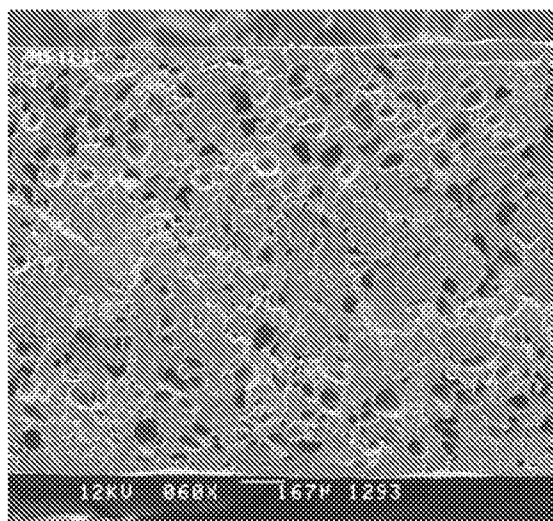
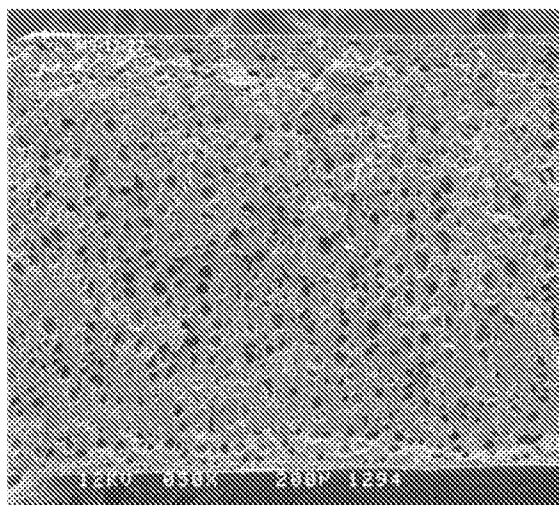
Polypropylene PC 90635-PP
12 melt index; 0.40 wt% kinetic mixing particle;
P = 0,68 g/.cc, 163 μ

FIG. 32G**FIG. 32H**

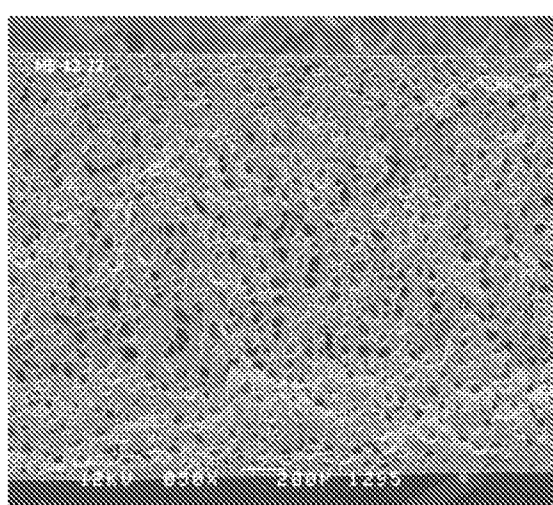
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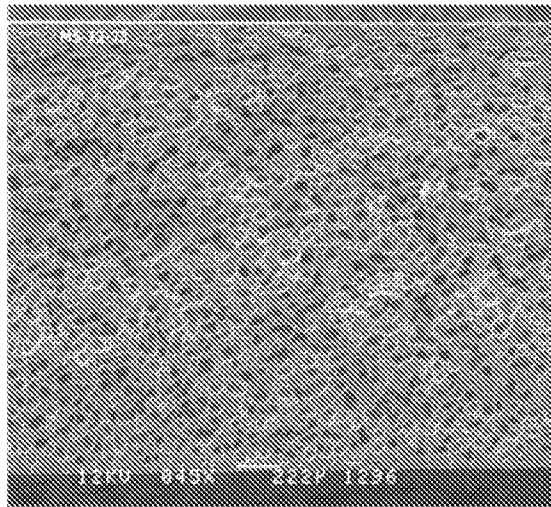
Polypropylene PC 90635-PP
12 melt index; 3.2 wt% kinetic mixing particle;
P = 0,66 g/cc, 63 μ

FIG. 32I**FIG. 32J**

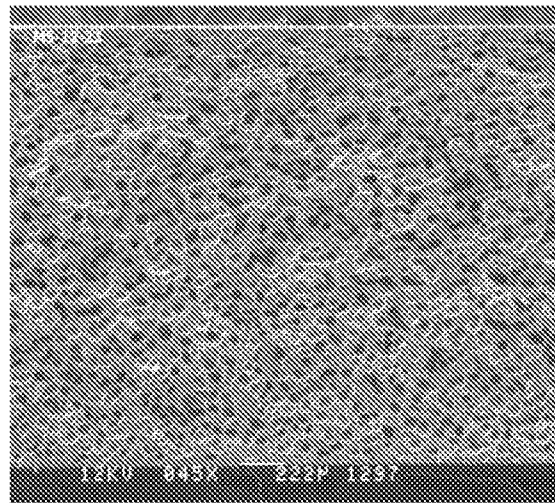
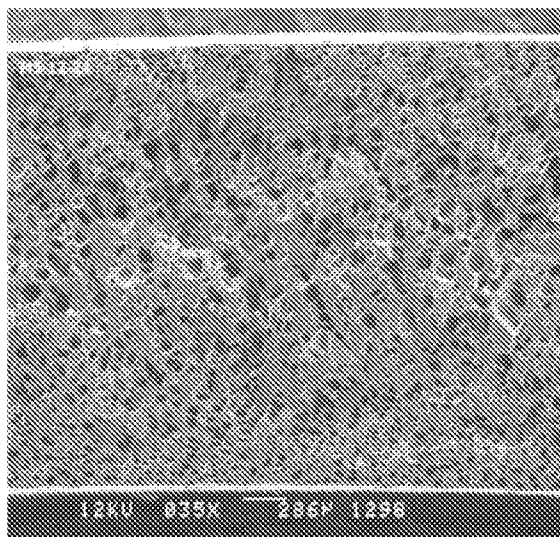
Polypropylene PC 90635-PP
12 melt index; 4.8 wt% kinetic mixing particle;
P = 0,65 g/cc, 45 μ

FIG. 32K**FIG. 32L**

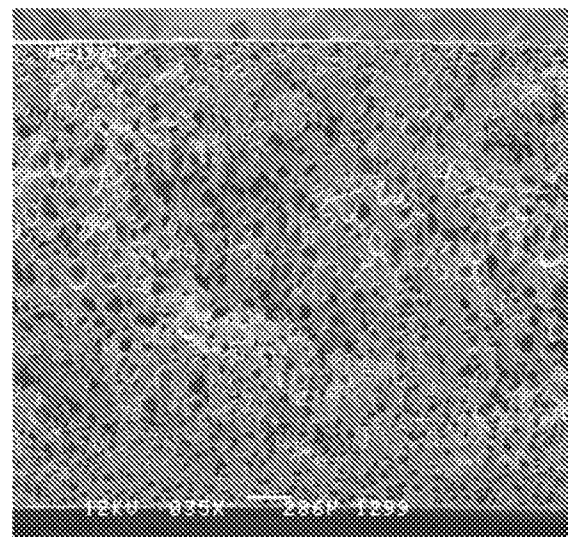
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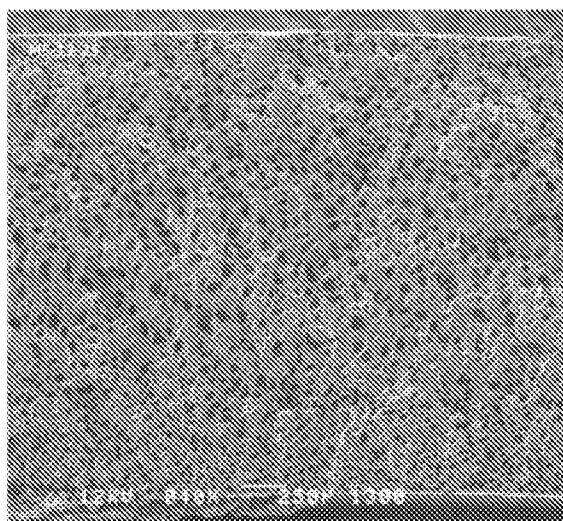
Polypropylene PC 90635-PP
12 melt index; 2.0 wt% kinetic mixing particle;
P = 0,65 g/cc, 63 μ

FIG. 32M**FIG. 32N**

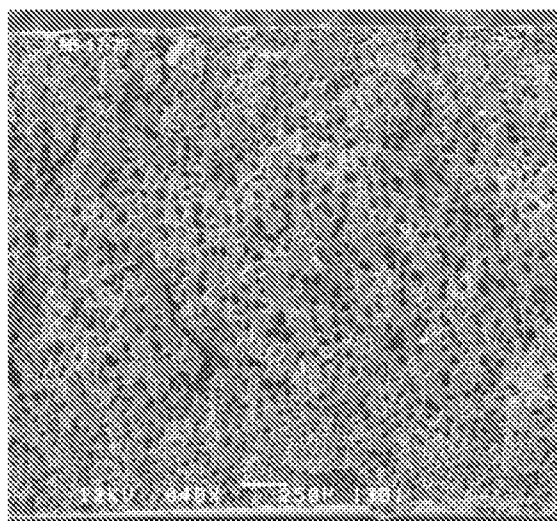
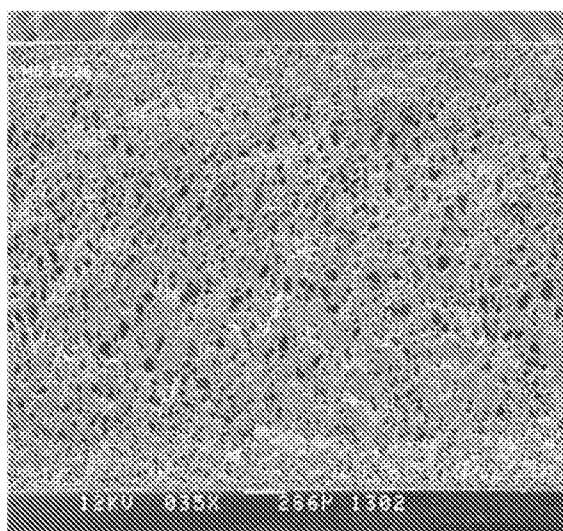
High Impact Polystyrene HC 80634-HIPS
8 melt index; 1.75 wt% kinetic mixing particle;
P = 0,70 g/cc, 42 μ

FIG. 32O**FIG. 32P**

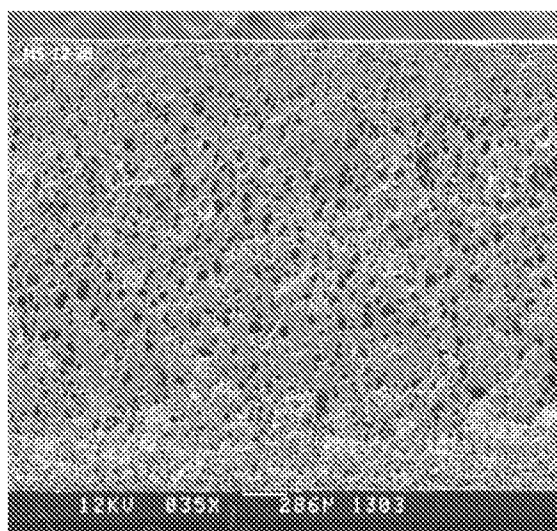
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High Impact Polystyrene HC 80634-HIPS
8 melt index; 2.80 wt% kinetic mixing particle;
P = 0,70 g/.cc, 85 μ

FIG. 32Q**FIG. 32R**

High Impact Polystyrene HC 80634-HIPS
8 melt index; 4.20 wt% kinetic mixing particle;
P = 0,69 g/.cc, 54 μ

FIG. 32S**FIG. 32T**

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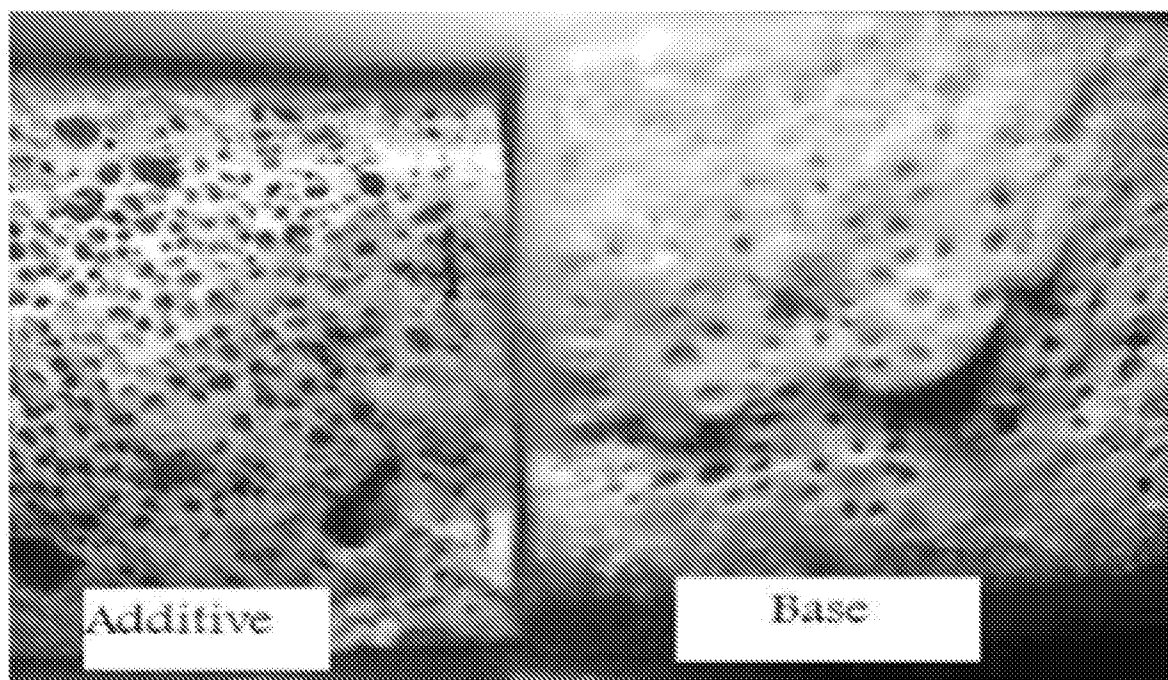


FIG. 33

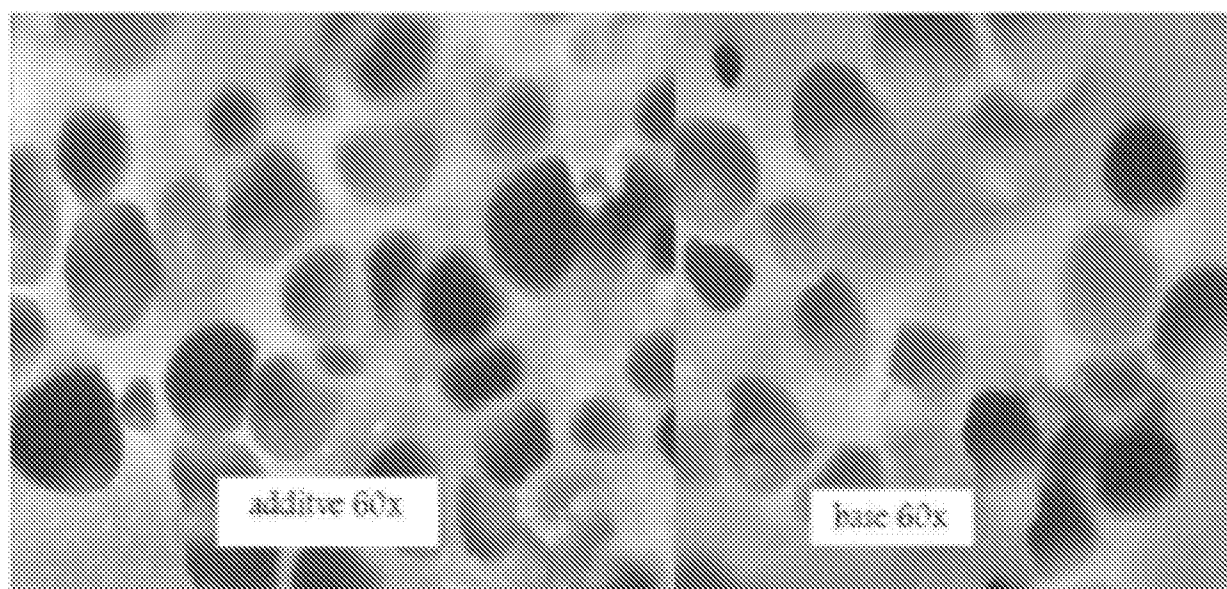


FIG. 34