[0001] likely because an increase of solid fraction ϕ means more microposts in a unit area. FIG. 10 is a plot of water droplet sliding velocity v_o, for a test in which the surface was tilted at 30°, as a function of solid fraction ϕ for 1000 cSt silicone oil. The plot shows that sliding velocity v_o decreased when the solid fraction ϕ increased, due to increased pinning.

[0002] FIGS. 11 and 12 show additional experimental measurements of water droplet sliding velocity v_o for different impregnating fluids having different viscosities, when the surface was tilted to 30°. The figures show that sliding velocity v_o with air is higher than with silicone oils, but sliding velocity v_o has the same decreasing trend with solid fraction ϕ due to increased pinning. FIG. 12 is a plot of sliding velocity v_o as a function of solid fraction ϕ for 10 cSt silicone oil. The plot shows that the magnitude of sliding velocity v_o is higher than with 1000 cSt but less than with air. The trend with solid fraction ϕ remains the same. The measurements in FIGS. 10 and 12 show that droplet mobility (e.g., sliding velocity v_o) increases as the viscosity of the impregnating liquid decreases. This suggests that the greatest mobility is likely achieved low viscosity impregnating fluids, such as air.

[0003] In one experiment, the viscosity of the impregnating liquid was varied to determine the influence of viscosity on droplet impingement. The surface used for the test included silicon microposts (10x10x10 μm) with a post spacing of 10 μm. When the viscosity of the impregnating liquid was 10 cSt, the impinging water droplet was able to bounce-off the liquid-impregnated surface. By contrast, when the viscosity of the impregnating liquid was 1000 cSt, the impinging water droplet remained on the surface (i.e., it did not bounce off the surface). Unlike a similar impingement experiment conducted with a gas-impregnated surface, however, the droplet was able to subsequently roll-off the surface, although the sliding velocity was low.

[0004] FIGS. 13 and 14 include Environmental SEM (ESEM) images of frost nucleation on micropost surfaces impregnated with silicone oil. FIG. 13 shows a surface 1402 before nucleation was triggered. FIG. 14 shows a surface 1404 during nucleation and indicates that frost 1306 had the tendency to nucleate on the micropost tops.

Equivalents

[0005] While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[0006] ~~What is claimed is:~~

What is claimed is:

1. An article comprising a liquid-impregnated surface, said surface comprising a ~~matrix~~ plurality of micro-scale and/or nano-scale solid ~~of~~ features spaced sufficiently close to stably contain an impregnating liquid therebetween ~~or therewithin~~, said surface stably containing said impregnating liquid between said solid features, wherein said impregnating liquid fills the space between said solid features, and is held in place between said solid features despite movement of said surface..

2. The article of claim 1, wherein said liquid has viscosity at room temperature no greater than ~~about~~ 1000 cP or no greater than 100 cP or no greater than 50 cP and/or wherein said liquid has vapor pressure at room temperature no greater than about 20 mm Hg..

~~3. The article of claim 1 or 2, wherein said liquid has vapor pressure at room temperature no greater than about 20 mm Hg.~~

~~4. The article of claim 2, wherein said liquid has a viscosity at room temperature no greater than about 100 cP.~~

~~5. The article of claim 2, wherein said liquid has a viscosity at room temperature no greater than about 50 cP.~~

~~6~~3. The The article of any one of the preceding claims, wherein the features have substantially uniform height and wherein the liquid ~~fills space between the features and~~ coats the features with a layer at least about 5 nm in thickness over the top of the features..

~~7~~4. The article of any one of the preceding claims, wherein the features define pores or other wells and wherein the liquid fills the features.

~~8~~5. The article of any one of the preceding claims, wherein the liquid has receding contact angle of 0° such that the liquid forms a stable thin film on the top of the features.

~~9~~6. The article of any one of the preceding claims, wherein ~~the matrix has a~~ feature-to-feature spacing is from ~~about~~ 1 micrometer to ~~about~~ 100 micrometers.

~~10~~7. The article of any one of the preceding claims, wherein ~~the matrix has a~~ feature-to-feature spacing is from ~~about~~ 5 nanometers to ~~about~~ 1 micrometer.

~~11~~8. The article of any one of the preceding claims, wherein the ~~matrix~~ features comprises hierarchical structures.

~~12~~9. The article of claim ~~11~~8, wherein the hierarchical structures are micro-scale features that comprise nano-scale features thereupon.

~~13~~10. The article of any one of the preceding claims, wherein the features have height no greater than about 100 micrometers.

~~14. The article of any one of the preceding claims, wherein the features are posts.~~

~~15~~11. The article of any one of the preceding claims, wherein the features comprise at least one member selected from the group consisting of a post, a spherical particle, a nanoneedle, a nanograss, and a random geometry feature that provides surface roughness.

~~16~~12. The article of any one of the preceding claims, wherein the features comprise at least one member selected from the group consisting of a pore, a cavity, interconnected pores, and interconnected cavities.

~~17~~13. The article of claim ~~16~~12, wherein the surface comprises porous media with a plurality of pores having different sizes.

~~18~~14. The article of any one of the preceding claims, wherein the liquid comprises a member selected from the group consisting of silicone oil, a perfluorocarbon liquid, a perfluoroFluorinated ~~vaccum~~ vacuum oil (such as Krytox 1506 or Fromblin 06/6), a fluorinated coolant (e.g., perfluoro-tripentylamine sold as FC-70, manufactured by 3M), an ionic liquid, a fluorinated ionic liquid that is immiscible with water, a silicone oil comprising PDMS, a fluorinated silicone oil, a liquid metal, an electro-rheological fluid, a magneto-rheological fluid, a ferrofluid, a dielectric liquid, a hydrocarbon liquid, a fluorocarbon liquid, a refrigerant, a vacuum oil, a phase-change material, a semi-liquid, grease, synovial fluid, bodily fluid.

~~19~~15. The article of any one of the preceding claims, wherein the article is a member selected from the group consisting of a steam turbine part, a gas turbine part, an aircraft part, and a wind turbine part, and wherein the liquid-impregnated surface is configured to repel impinging liquid.

~~20~~16. The article of any one of claims 1-~~18~~14, wherein the article is a member selected from the group consisting of eyeglasses and a mirror, and wherein the liquid-impregnated surface is configured to inhibit fogging thereupon.

~~21~~17. The article of any one of claims 1-~~18~~14, wherein the article is a member selected from the group consisting of an aircraft part, a wind turbine, a power transmission line, and a windshield, and wherein the liquid-impregnated surface is configured to inhibit formation of ice thereupon.

~~22~~18. The article of any one of claims 1-~~18~~14, wherein the article is a pipeline (or a part or coating thereof), and wherein the liquid-impregnated surface is configured to inhibit the formation of hydrate thereupon and/or enhance the slippage (reduce drag) of fluid flowing thereupon or

wherein the article is an engine part (e.g., piston or cylinder), and wherein the liquid-impregnated surface is configured to provide long-lasting lubrication of the part, wherein the liquid-impregnated surface is optionally configured to release liquid from the surface over time, thereby providing lubrication over time or

wherein the article is a heat exchanger part, and wherein the liquid-impregnated surface is configured to facilitate shedding of condensate thereupon, thereby enhancing condensation heat transfer.

~~23~~19. The article of any one of claims 1-~~18~~14, wherein the article is a heat exchanger part or an oil or gas pipeline (or a part or coating thereof), and wherein the liquid-impregnated surface is configured to inhibit the formation and/or adhesion of salt thereupon.

~~24~~20. The article of any one of claims 1-~~18~~14, wherein the liquid-impregnated surface is configured to inhibit corrosion and/or wherein the liquid-impregnated surface is an anti-fouling surface configured to resist adsorption of debris thereupon.

21. The article of any one of the preceding claims, wherein $0< \varphi <0.5$, where φ is the surface area fraction of said surface in direct contact with a non-wetted phase, and wherein said surface is a textured surface and said solid features are engineered protrusions of said textured surface.

22. The article of claim 21, wherein $0< \varphi \leq 0.25$.

23. The article of any one of the preceding claims, wherein said impregnated liquid is held in place between said plurality of micro-scale and/or nano-scale solid features despite movement of air or other fluid over said surface.

~~25~~24. The article of any one of claims 1-~~18~~14, wherein the article is an artificial joint and wherein the liquid-impregnated surface is configured to reduce friction between mating surfaces and/or provide long-lasting lubrication of the joint.

~~26. The article of any one of claims 1-18, wherein the article is an engine part (e.g., piston or cylinder), and wherein the liquid-impregnated surface is configured to provide long-lasting lubrication of the part.~~

~~27~~25. The article of claim ~~24~~25 ~~or 26~~, wherein the liquid-impregnated surface is configured to release liquid from the surface over time, thereby providing lubrication over time.

~~28. The article of any one of claims 1-18, wherein the liquid-impregnated surface is an anti-fouling surface configured to resist adsorption of debris thereupon.~~

~~29. The article of any one of claims 1-18, wherein the article is a heat exchanger part, and wherein the liquid-impregnated surface is configured to facilitate shedding of condensate thereupon, thereby enhancing condensation heat transfer.~~