Superhydrophobic coatings from water-based beeswax emulsions

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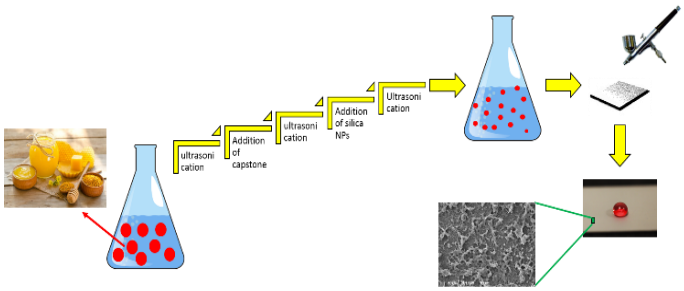
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Abstract

Superhydrophobic coatings have attracted a lot of attention due to their wide applications in different aspects of the life. However, the practical applications of the artificial superhydrophobic coatings are restricted by issues related to durability and environmental concerns due to chemicals used. Herein, an organic solvent-free superhydrophobic coating based on natural wax- beeswax- was developed through oil-in-water emulsion process. An aqueous perfluorinated acrylic copolymer (PFAC; Capstone ST-100) used as an internal surfactant to make stable beeswax emulsion. Ultrasonication of the wax emulsion is useful to decrease the emulsified particle size and better dispersion of beeswax in water. The coatings were prepared by spray coating method along with thermal annealing at 170˚C. The contact angle and roll-off angle of this coating were measured about 116.18˚ and 90˚ (sticky water droplet), respectively.

To reach superhydrophobicity level and to create rough structures on the surface, silica nanoparticles (Aerosil-300) were added to the emulsion. By adding proper amount of hydrophilic silica nanoparticles, the contact angle of the resulted nanocomposite improved to higher value and roll-off value reached less than 10˚. The wetting properties of the obtained coatings revealed self-cleaning property. The particle size distribution and structure of the particles inside the emulsion were studied by dynamic light scattering (DLS) and transmission electron microscopy (TEM), respectively. Both of these measurements proved the core-shell structure of the emulsified particles. The coating's surface morphology and average roughness value were examined by scanning electron microscopy (SEM) and atomic force microscopy (AFM). It is obvious that by utilization of silica nanoparticles, the average roughness value increased, which is in agreement with the results of the wetting properties. Due to the simple fabrication method and biodegradability of the materials, it can be used as a coating in different applications, such as; textile, water-based paint, oil phase separation and biomedical applications.

Image



Recent Publications

1. Wei Wang, Karsten Lockwood, Lewis M. Boyd, Matthew D. Davidson, Sanli Movafaghi, Hamed Vahabi, Salman R. Khetani, and Arun K. Kota (2016). Superhydrophobic Coatings with Edible Materials. ACS Appl. Mater. Interfaces, 8, 18664−18668.

2. Sara Naderizadeh, Athanassia Athanassiou[a], Ilker S. Bayer (2018). Interfacing Superhydrophobic Silica Nanoparticle Films with Graphene and Thermoplastic Polyurethane for Wear/Abrasion Resistance. Journal of Colloid and Interface Science.

3. Reshmi C. R., Suja P. Sundaran, Juraij A. and Sujith Athiyanathil (2017). Fabrication of superhydrophobic polycaprolactone/beeswax electrospun membranes for high-efficiency oil/water separation. RSC Adv., 7, 2092.

4. Wewei Zhang, Peng Lu, Liying Qian, Huining Xiao (2014). Fabrication of superhydrophobic paper surface via wax mixture coating. Chemical Engineering Journal 250, 431–436.

5. Wang, P., Qian, X., and Shen, J (2018). Superhydrophobic coatings with edible biowaxes for reducing or eliminating liquid residues of foods and drinks in containers, *BioRes.* 13(1), 1-2.

6. Xia Zhao, Tao Hu, Junping Zhang (2018). Superhydrophobic coatings with high repellency to daily consumed liquid foods based on food grade waxes. Journal of Colloid and Interface Science, 515, 255-263.



Biography

Sara Naderizadeh is the PhD student in Smart Materials Group, in Italian Institute of Technology (iit), Genova, Italy. She is in the second year of PhD, and her background was Polymer chemistry. She was experted in fabrication of polymer nanocomposites and she is continuing her work in the field of polymer science and mainly the application of polymers in different aspects. Now, she is doing her research about superhydrophobic coating based on different materials mainly polymers via different methods, which can be used in various areas.

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Notes/Comments: Authors declare no financial conflict of interest.

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