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Selection and characterization of innovative solutions for biphilic surfaces

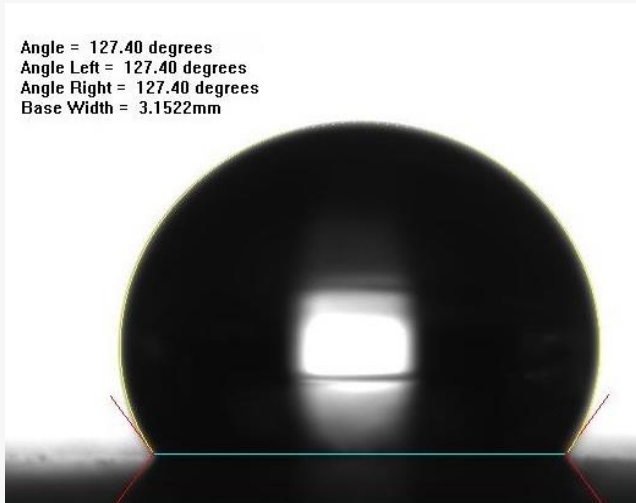
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Motivation and Context

- Selection, characterization and evaluation of materials for the superamphiphobic spots on biphilic surfaces

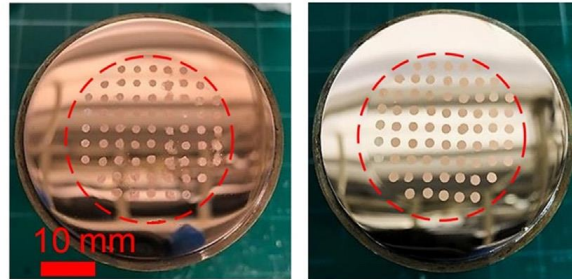


Figure 1 – Superamphiphobic spots on a biphilic surface. Source: Shen et al ATE 2019

Objectives

- Selection of superamphiphobic materials
- Selection of the composition and design of the coatings
- Assessment of the characteristics of interest of the coatings
- Development of laboratory improving methods and industrial innovative procedures

- Superamphiphobic materials:
- Silane (SiH₄) containing compounds – Fluorosilane, Chlorosilane, PDMS, TMS, PFDS

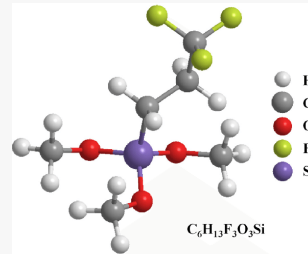


Figure 2 – Chemical structure of a containing fluorosilane compound.

Source: researchgate.net

- Polysilicon
- Fluoropolymer

Types of fluoropolymers		
PCTFE	Poly chloro tri fluoro ethylene	$-(CF_2-CFCl)_n-$
PFA	Tetra fluoro ethylene perfluoro alkyl vinyl ether copolymer	$-(CF_2-CF_2)_m-(CF_2-CF)_n-$ ORf
FEP	Fluorinated ethylene propylene copolymer	$-(CF_2-CF_2)_m-(CF_2-CF)_n-$ CF ₃
ETFE	Ethylene-tetrafluoroethylene copolymer	$-(CF_2-CF_2)_m-(CH_2-CH_2)_n-$
PVDF	Polyvinylidene difluoride	$-(CF_2-CH_2)_n-$
PTFE	Polytetrafluoro Ethylene	$-(CF_2-CF_2)_n-$

Table 1 – Types of fluoropolymers. Source: toho-sekei.com

- Composition of the coatings:
- Diatomaceous earth or diatomite (DE) ($\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$)

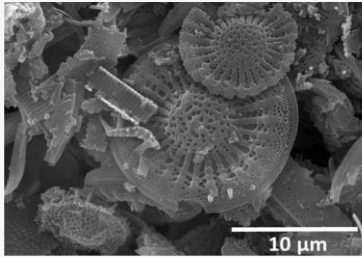


Figure 3 – Diatomite (DE) microstructure.

Source: Brishma et al ASS 2016

- Halloysite nanoclay ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$)

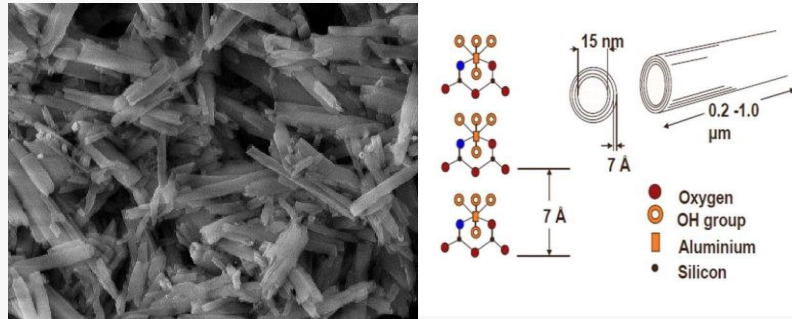
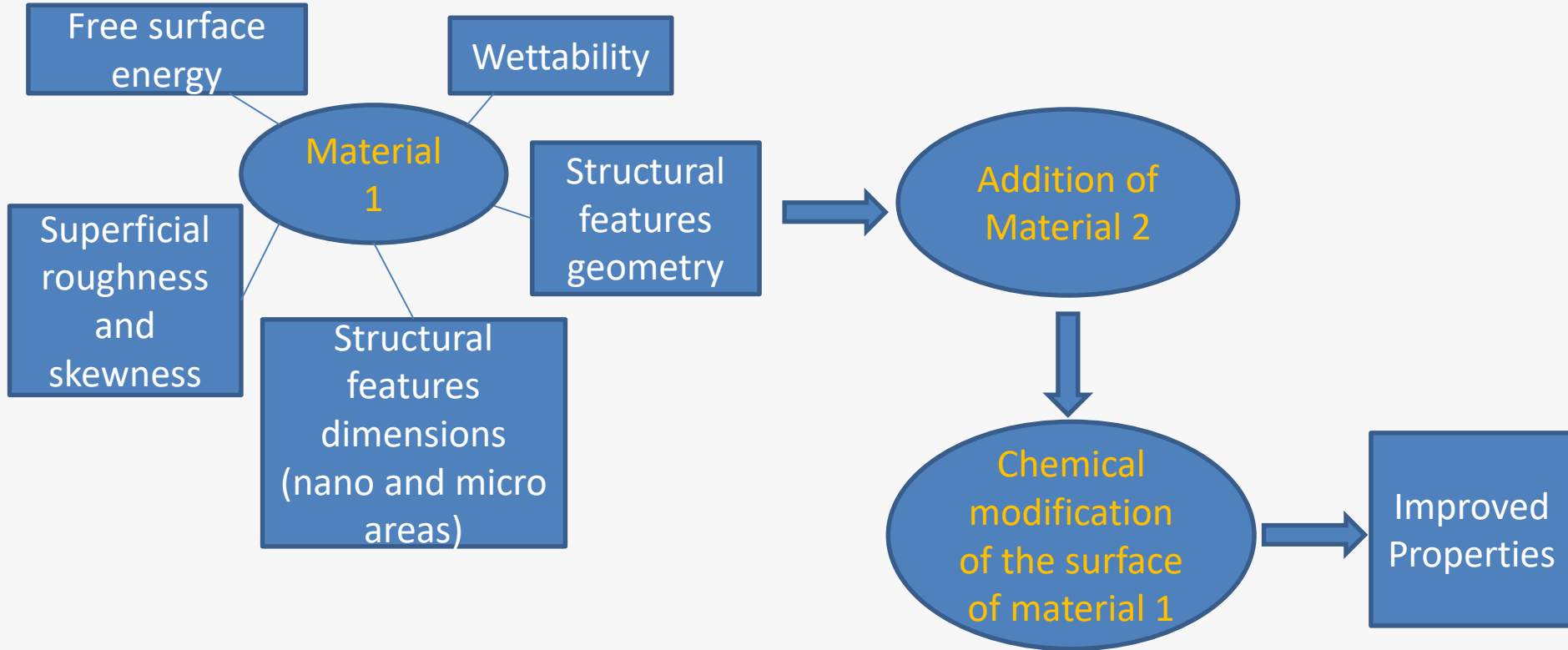


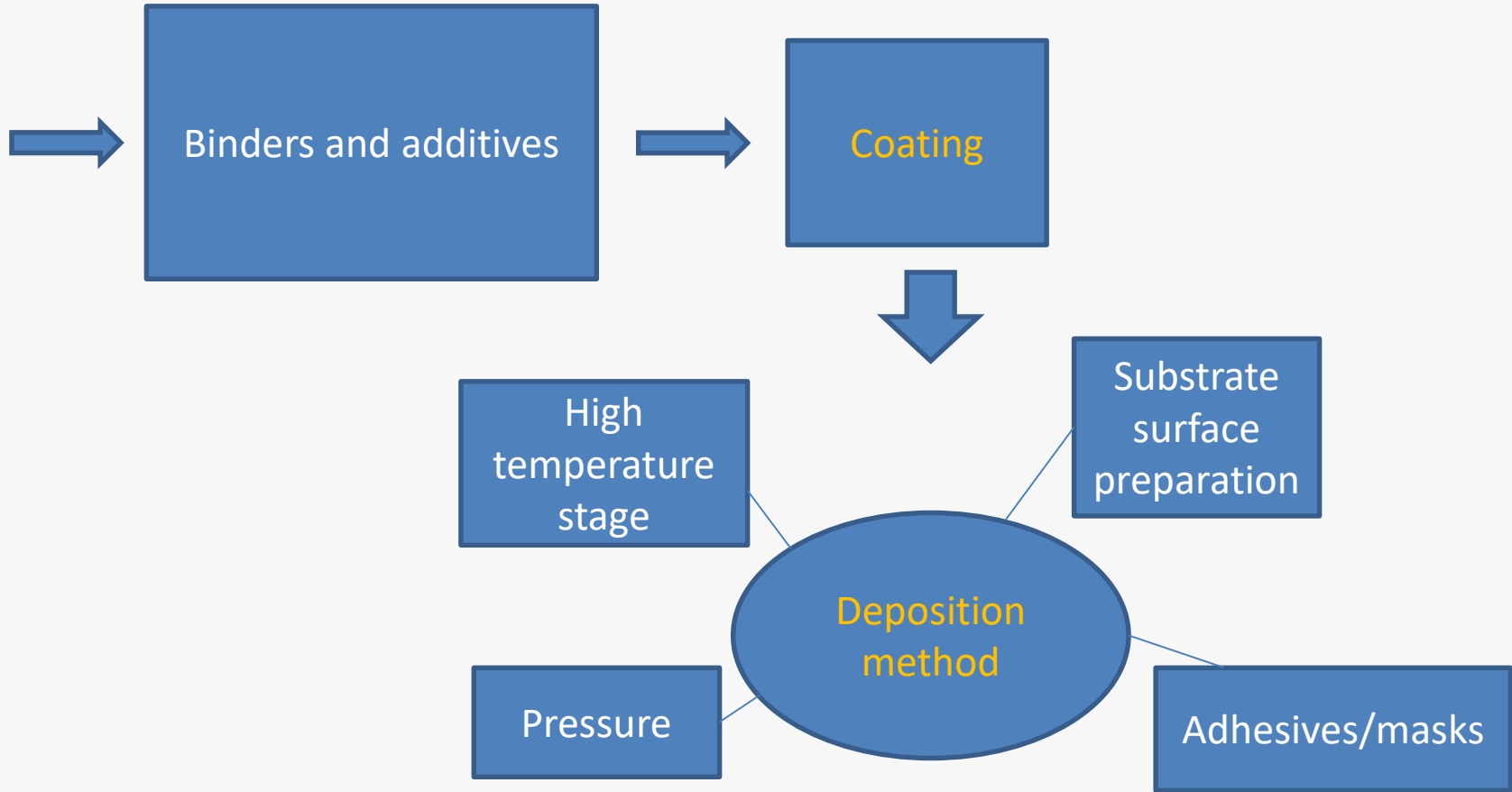
Figure 4 – Halloysite microstructure and dimensional characteristics. Source: naturalnano.com



PDMS, TMS, PFDS

- Design of the coatings





- Assessment of the characteristics of interest of the coatings
- Superamphiphobicity (contact angle $> 150^\circ$)

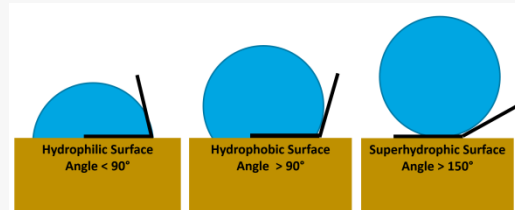


Figure 4 – Contact angles for different types of surfaces. Source: sciencedirect.com

- Heat resistance (pool-boiling regimes)

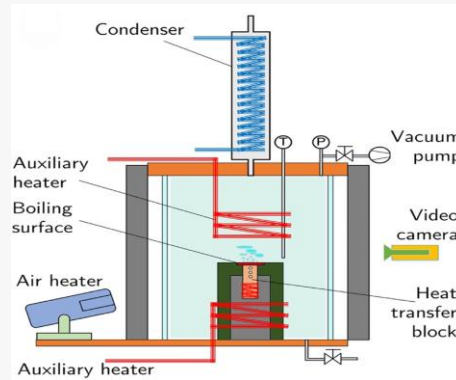


Figure 5 – Typical set-up for pool boiling studies.

Source: Shen et Al ATE 2019

- Corrosion resistance
- Abrasion resistance
- Scratch resistance

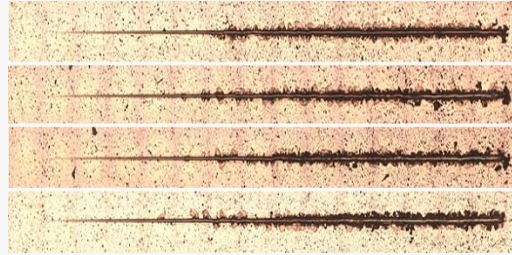


Figure 6 – Coating scratch resistance testing. Source: nanovea.com

- Self-cleaning

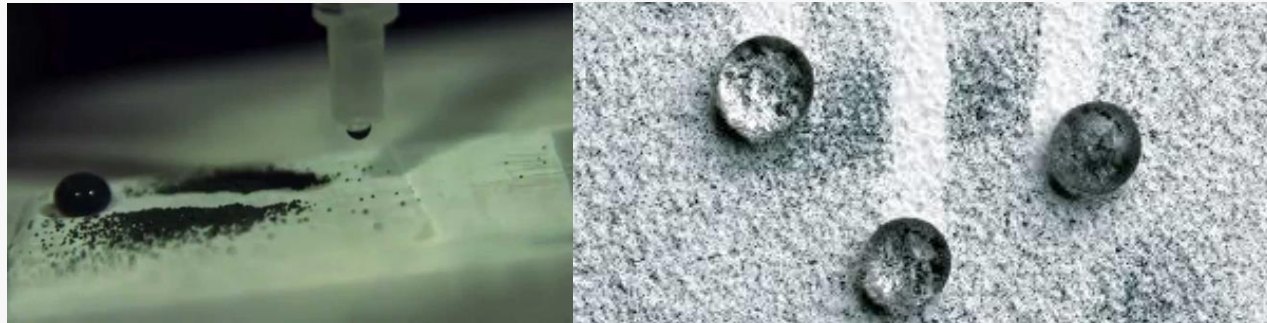


Figure 7 – Coating self-cleaning testing.

Source: independent.co.uk

- Development of laboratory improving methods and industrial innovative procedures

- Brush
- Spray
- Immersion
- Adhesives

Thank you for your attention!