Objectives and activities - Period III-2015

Objective 1. Studies regarding composite coating preparation

1.1. Selection of solvent and crosslinker

1.2. Optimize synthesis parameters: nanoparticle to matrix ratio, solvent and crosslinker concentration, curing time and temperature

1.3. Preliminary study regarding nanoparticle colloidal aggregation during curing: coating characterization regarding surface morphology (optical, SEM and TEM microscopy) and water drop contact angle

1.4. Re-optimize coating formulation targeting the most uniform patterning resulting in the highest contact angle

Conclusions

Three types of hybrid film formulations were proposed and optimized. They are classified based on the nature of the nanoparticles that aggregate to generate surface roughness, namely: A. magnetite nanoparticles coated with sodium oleate (MagNaOL); B. composite magnetic chitosan grafted with acrylates or styrene nanoparticles (MagCSgBMA; MagCSgBA; MagCSgHA; MagCSgST); C. magnetite nanoparticles coated with aminopropyl triethoxysilane (MagAPTES).

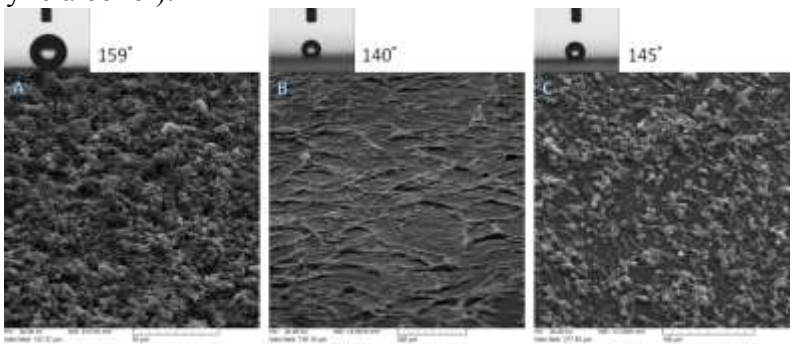
- The optimum method to prepare the coatings is in bi-component structure, layer by layer, deposited by airbrush.
- The formulations contain three main elements: the nanoparticles that generate surface roughness, the polymeric binder (either chitosan in acidic solution or a pre-polymer of chitosan crosslinked with ethylene glycol dimethylmethacrylate) and the coupling agent (partially hydrolyzed alkoxysilane).
- All the prepared films show rough surface, with micro-scale protuberances that retain nano-scale features.
- The colloidal aggregation mechanism depends on the type of nanoparticles, namely:

A. Assembly due to residual magnetization (MagNaOL);

B. Assembly caused by covalent and/or hydrogen bonding due to silanol bridges formed by the coupling agent (MagCSgST);

C. Assembly induced both by residual magnetization and by phase separation within the polymeric binder during the curing stage (MagAPTES).

- The hybrid films prepared with MagNaOL particles present the maximum wetting angle and superhydrophobic properties.
- All three types of formulations use environmentally friendly materials (magnetite, chitosan, ethylic alcohol).



SEM images, wetting angles and water drop images on the surfaces of hybrid films prepared with the particles: A. MagNaOL; B. MagCSgST; C. MagAPTES

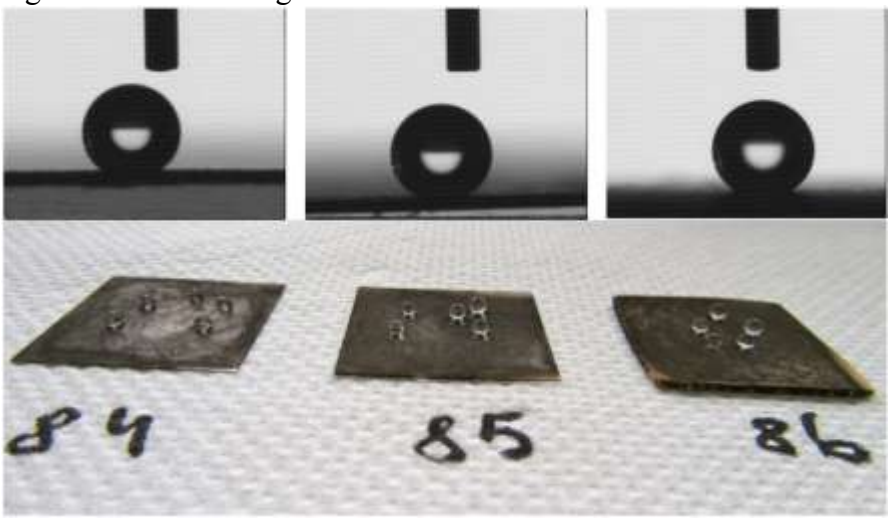
Objective 2. Casting method optimization

2.1. Select casting and surface pre-treatment method depending on the surface nature (glass, plastic, metal sheet)

2.2. Experimental evaluation of the casting method parameters on various substrates

Conclusions

- The casting method was optimized for three types of substrates. The obtained wetting angles were in the range of 140 to 154^0.



Hybrid coatings prepared by the optimum method with MagNaOL particles deposited on glass(84), plastic (85) and metal sheet (86)

Objective 3. Laboratory scale preparation of the composite coating using the optimum formulation and the best casting method

3.1. Obtaining a test batch of composite coating using the optimum formulation

Conclusions

Five batches of magnetite synthesized by partial oxidation were mixed together to yield a test lot. This was divided into three portions for coating with sodium oleate. Some of the material has been used for films deposited on various substrates and some is kept for the reproducibility study.