Coating of polymers

The process of polymer coating finds extensive use in almost all sectors ranging from automotive and packaging industries to kitchen wares and energy devices to membrane and biomedical technologies. In principle, the binding of a thin layer of polymer molecules to substrate surfaces either physically or chemically is termed as a polymer coating. A variety of materials such as glass, metals, plastics, wood and others can be coated by polymers. The application of a polymer coat allows for the modification of the substrate surface properties for the purposes of tailoring adhesion, barrier properties, biocompatibility, wettability, chemical and abrasion resistance, etc… of the material as required. For example, metal surfaces covered with a top layer of polymer have been used to resist corrosion. Though polymer coatings are primarily organic, recent advancements have enabled the inclusion of other materials such as metals, ceramics or nanoparticles to improve the performance of the applied coats. It is therefore imperative to make certain the use of the proper coating material and technique to fabricate highly operational coatings with advanced properties.

Interfacial adhesion of polymer coatings

Adhesion by definition means the inter-atomic and inter-molecular interactions that occur at when two adjacent phases come into contact with each other. The quality of the applied coating therefore depends on the adhesiveness between the polymer material and the substrate surface, which is quantified in terms of work of adhesion (i.e., the thermodynamic work required to separate two phases in equilibrium). Also the interfacial adhesion between substrate and coating is related to the surface energy and wettability properties of the substrate which can be evaluated by means of contact angle measurements. In general, a small contact angle is indicative of a substrate with more surface energy, substantial wettability and consequently, a higher work of adhesion. For example smooth surfaces of pure metals have low contact angles and hence, exhibit good adhesion to polymer liquids.

What we offer?

Droplet lab introduces dropometer, a smartphone based optical tensiometer to measure the surface properties of materials. The instrument can be used to determine surface energies and tensions up to 100 mN m^{-1}. Contact angle and sliding angle of 0° - 175° can also be measured. The innovative tensiometer can be used to regulate the properties of polymer coatings and surfaces. The applications of the tensiometer include, but are not limited to the following:

- Determine wettability of surfaces for coating polymers
- Conduct advance and receding contact angle measurements
- Determine surface tension of polymer coatings
- Optimize polymer composition for specific substrates
- Asses the roughness of substrates
- Determine the polymer adhesiveness to substrates
- Asses hydrophobicity/ hydrophilicity of applied coatings
- Evaluate the stability of the polymer coating

Our Industrial Clients

- Avery Dennison Corporation, Glendale, California
- Teledyne FLIR LLC, Wilsonville, Oregon

Some relevant case studies

1. Hybrid organic/ inorganic polymer coatings

The design of hybrid organic/ inorganic polymer materials has delivered a range of high performance coatings. These hybrid coatings are more advantageous than the conventional homogenous polymer coats and possess strategic features for use in applications of self-cleaning, anti-corrosion, anti-fouling, self-healing, water/ oil separation, etc… The evaluation of surface properties of an organic/ inorganic hybrid coating of Fluorolink S10, a commercial perfluoropolyether (three different molecular weights - 1100, 1550 and 2000 g/mol) having alkoxysilane terminal groups prepared by a sol-gel reaction for use as functional hydrophobic/ oleophobic coatings has been reported[1].

[1] 10.1002/app.24350

		Sol–gel reaction time before coating (min)	Surface Tension (mN/ m)	Contact angle (°)	
				Water	n-Hexadecane
1.	Glass substrate	-	59.9	37.4	12.9
2.	Silica coated glass substrate	0	46.4	57.0	24.4
3.	Fluorolink S10-1100/ silica coated glass substrate	0	15.0	108.3	65.8
		30	16.2	104.4	64.2
		60	16.1	104.6	64.5
4.	Fluorolink S10-1550/ silica coated glass substrate	0	14.7	108.3	67.0
		30	16.1	103.8	65.1

		60	14.8	107.9	66.8
5.	Fluorolink S10-2000/ silica coated glass substrate	0	13.6	112.4	68.5
		30	15.6	106.1	65.0
		60	14.5	109.0	67.0

S. No **Sample**

2. Polymer coatings for preservation of stone monuments

Polymer coatings have been employed to provide protection to underlying materials from external factors that cause damage to its quality. Stone monuments are representations of age-old cultural heritage. These stone structures over time have undergone considerable deterioration due to weathering, induced by both natural and anthropogenic activities. The efficacy of five synthetic polymer hydrophobic coatings of varied compositions towards the preservation of selected stone sample substrates representative of the monument structures by offering resistance against water has been reported[2].

Stone substrate	Applied synthetic polymer coat	Contact angle (°)
	Bayer LF	96.1
	Rhodorsil 224	94.8
Marble 'Ajax' of Drama	Wacker 290	112.3
	Akeogard P	109.0
	Ftorsam-39	92.0
	Bayer LF	95.5
	Rhodorsil 224	95.0
Marble of Thassos	Wacker 290	94.1
	Akeogard P	98.7
	Ftorsam-39	95.5
Porous stone of Kilkis	Bayer LF	90.3
	Rhodorsil 224	92.9
	Wacker 290	100.7
	Akeogard P	92.3

[2] 10.1016/j.culher.2006.06.007

	Ftorsam-39	90.0
	Bayer LF	143.9
	Rhodorsil 224	140.9
Sandstone of Turkey	Wacker 290	124.7
	Akeogard P	-
	Ftorsam-39	125.4
	Bayer LF	123.2
	Rhodorsil 224	136.6
Brick	Wacker 290	137.7
	Akeogard P	114.9
	Ftorsam-39	127.4