Sio_2/ Polyamide Nanocomposite Textile for Super Hydrophobic Coating By Electrospinning Technique

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***Abstract*- Sio2/polyamide nano composites textile coating for hydrophobic surface by electros pinning technique was prepared. Celluloseball sample with prepared textile were coated by electros pinning system. Contact angle between water and samples (glass, glass + PA(coating) & glass + PA+Sio2 coating) surfaces were calculated.**

The fall time through water of cellulose ball (coating & non-coating) were calculated. Results show the contact angle between the non-coating surface sample and water droplet smaller than coating surface. This contact angle increase from (26o) of glass surface to (126.6o) of (glass+PACoating), also it increase to (128o) with adding silica nano particles to (PA coating) As well as , the fall time of coating ball with (PA) nano fibers is (6 sec) and it smaller than non-coating ball fall time (10 sec), also silica nano particles adding leads to decrease the fall time of ball to (5 sec).

Keywords: **super hydrophopic, contact angle, fall time, nano fibers coating**

I. INTRODUCTION

Material classified in the case of her behavior with water to two categories: hydrophobic and (Hydrophilic). Hydrophobic means that the substance does not combine or mix well with water [1]. Super hydrophobic materials replays water at very high contact angle, and allowing surfaces to remain dry. These materials leads to many benefits such as: ease of manufacture, low cost, scalability, small amount coats a large area, and eliminates water-based corrosion. [2] nanotechnology entered in this field, in order to improve the hydrophobic surfaces, scientists deliberately to form micro- and nano superficial protrusions, that will increase the balled water droplets (or even any other means), so as to protect an optimized surface, taking advantage of the surface structure of the lotus leaf , so he walked into materials science term " Lotus effect" refers to the hydrophobic surfaces.[3-6]Many researchers have made studies on the work of the hydrophobic coatings such as Tan et. al considered Polystyrene as a resourceful polymer for fabrication of excellent water repellent surfaces. [7]Also *Hou* et. al at 2007 presented the fabrication of SiO2/Polystyrene nano composite for super hydrophobic surface [8]

II. EXPERIMENTAL PART DETAILS

1.2 Materials

a. Polyamide-6 as white, transparent from Alibaba Company (China) to preparation nano fibers by electros pinning technique was used.
b. Formic acid from Sigma-Aldrichas a solvent was used.
c. Silica (Sio2) nano particles with (40 nm) diameter from Sigma-Aldrich offers Aldrich-791342,used as a reinforcement materials

2.2 Method

(0.15%)w/v concentration of polyamide solution by using hot plate magnetic stirrer were prepared for electro spinning nano fibers , this solution mixed with Sio2 nano particles for nano composites nano textile coating preparation. Fig (1) shows the electro spinning system which used to prepare the nano coating.

Clean glass slides used for preparation the nano coating film, by spinning for 5 hr. intermittently. Coating film with 1mmthikness was prepared. Contact angle according to *Wilhelmy Balance Method* was measured. Equation (1&2) used for contact angle calculated.

$$F=\gamma p \cos\theta \quad \dots (1)$$

where γ is the liquid surface tension, p is the perimeter of contact line (i.e., the same as the perimeter of solid sample's cross-section) and θ is the contact angle. Consequently, the total detected force change F on the balance is:

$$F= \gamma p \cos\theta - V\Delta\rho g \dots (2)$$

where V is the volume of the displaced liquid, $\Delta\rho$ is the difference in density between the liquid and air (or a second liquid), and g is the acceleration of gravity.[9] Surface tension of liquid by (JYW-200 A) from LARYEE Chain manufacture company) was tested. Density of liquid by picnometer method was performed.

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The second method for friction test by using cellulose small ball with (3 cm) diameter coating with nano polyamide/Sio2 textile was prepared. Glass tube with 1 m length and 5 cm width for calculation of the ball arrival time was used. Three balls (with & without) coating inside the glass tube was shot by extrusion gun, and arrival time to the other end of the glass tube by digital temporary was calculated as in fig (2). [1]

III. RESULT AND DISCUSSION:

1.3 Nano Coating Preparation

Electro spinning technique used for preparation of (PA nano textile fibers) and (PA-Sio2nanocomposite textile fibers) under certain conditions as in table (1).

Fig (1) show the typical set up of electro spinning system and Fig (3) show the SEM image of nano coating textile fibers which preparation at this search.

2.3 Fall Time of the Ball

Fig (2) and table (2) show the system which used for the fall time of the ball calculate. Results show the fall time of non-coating ball is bigger than the coating ball as in fig (4).

Non-coating ball took 10 seconds to reach the bottom of the glass tube through the water, while the ball coated nylon Nano fiber took 6 seconds only arrived in the bottom of the glass tube through the water, as ball coated nylon armed nano silica took only 5 seconds to reach the bottom of the tube through the water. This refers to the (PA+ Sio2) nano composites coating has high hydrophobic behavior and it cannot make any secondary bands with water and don't mix with water this make ball is dry [1] We notice from fig (4) the fall ball time decreases to (5 sec) with adding silica nano particles to PA nano fibers coating, this refers to increasing of the hydrophobic of the ball

3.3 Contact Angle

Results of contact angle show the (PA+Sio2) coating has highest contact angle about (128 o), this contact angle is bigger than (90o) and this refers to high hydrophobic behavior of sample. Also the results the contact angle of (PA) coating is about (126.5o) and it smaller than of contact angle of (PA+Sio2) coating, this is agree with previous results of (fall time of the ball), and it agree with B. N. Sahoo et. al [3&10]. Table (3) and fig (5) show the results of contact angle.

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Table I: The Condition of Preparation of Nano fibers Coating by Electro Spinning Technique

No.	Sample	Con.% w/v	Voltage kV	distance	Flaw rate ml/hr.	Needle diameter Mm	Conductivity of midia mS/cm
1	PA+FA solution	0.15	35	15	0.5	0.48	5
2	(1) + Sio_2	0.01 nanoparticles	35	15	0.5	0.48	5

Table II: Show the Fall Time of Samples

Samples	Fall time (sec)
Cellulose ball	10
Cellulose ball + PA coating	6
Cellulose ball + (PA+Sio_2) coating	5

Table III: Contact Angles of Samples

Sample	Water contact angle
Un coating Glass	26
Glass + PA coating	126.5
Glass + (PA+Sio_2) coating	130.5

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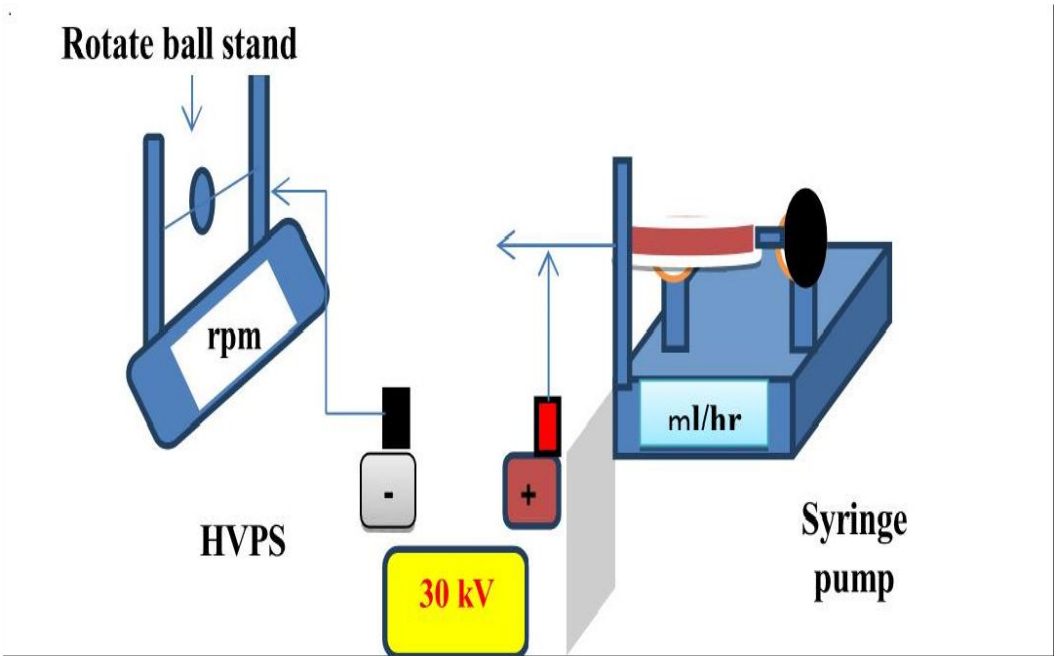


Fig. 1: Electro Spinning Set Up

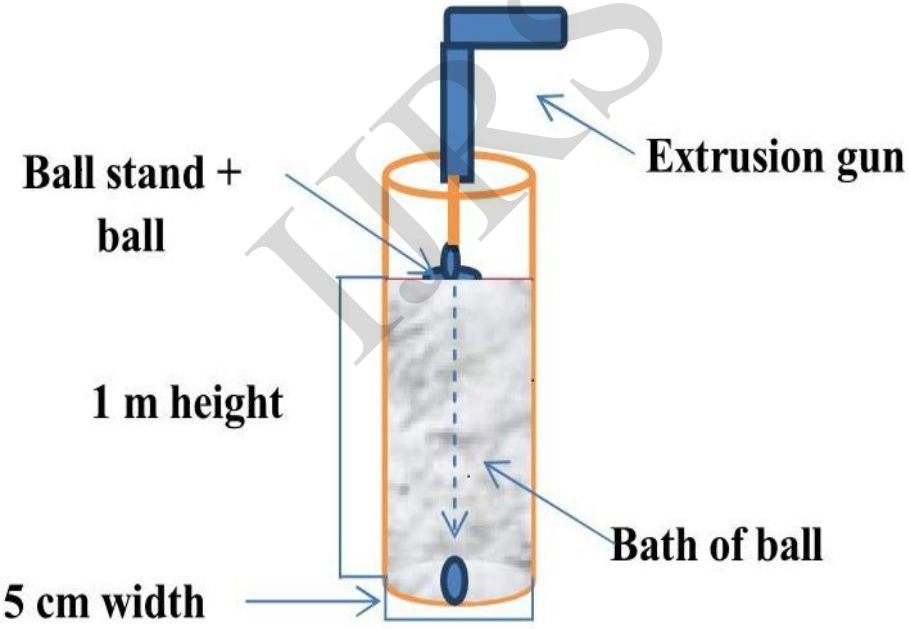


Fig. 2: Show the Fall Time Test of Ball Through the Water

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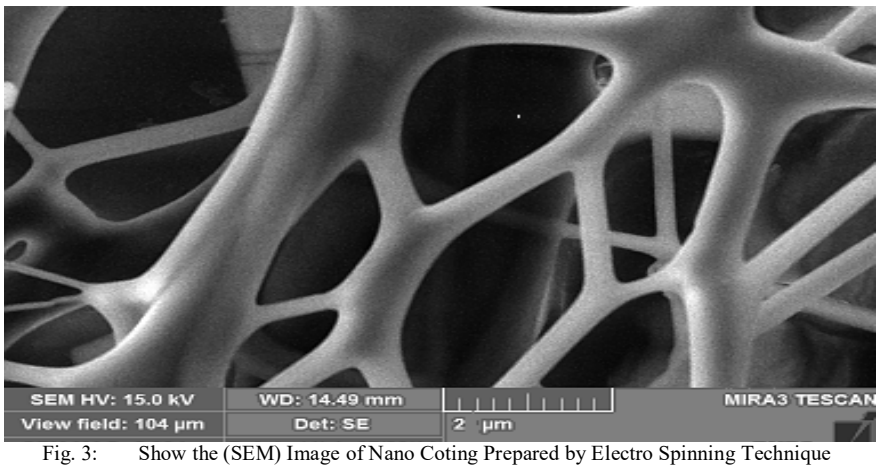


Fig. 3: Show the (SEM) Image of Nano Coting Prepared by Electro Spinning Technique

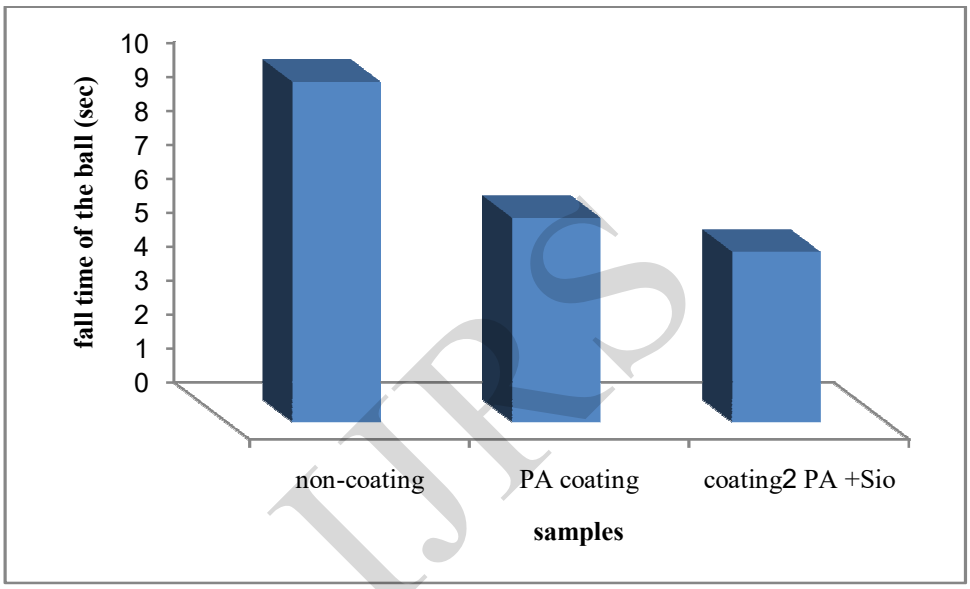


Fig. 4: Show the Relationship Between the Time of the Fall Ball and Types of Coating

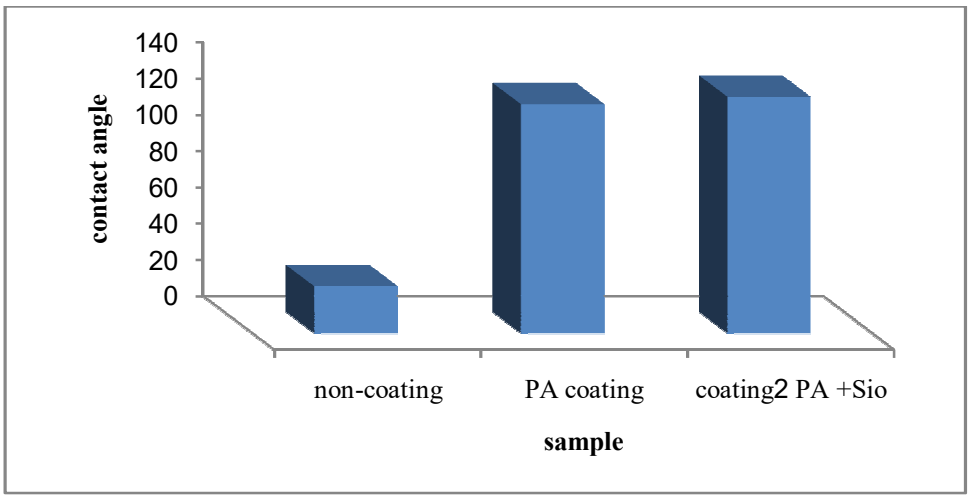


Fig. 5: Show the Relationship Between Contact Angle of Water and Types Of Coating

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