UDC 66.095.262

Generation of polymers in acetylene plasma

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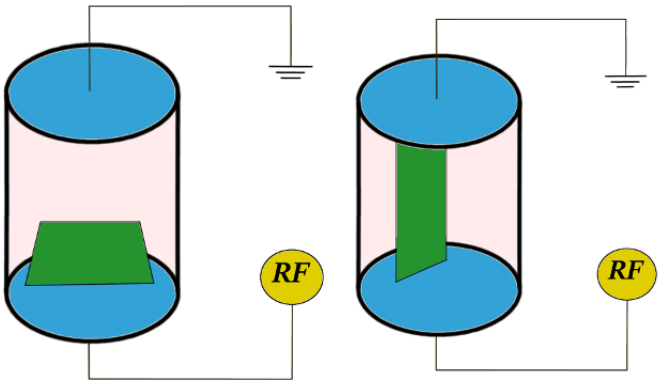
The vast variety of chemical and mechanical properties of polymers makes them have virtually endless applications. A polymer is a molecular compound made up of many repeating units and this process is usually carried out by chemists. But the physicists also have a medium to create polymers: the plasma. Some polymers created by plasma are unique, i.e. cannot be created by others media, and this open the door to a new field of study: Plasma Polymerization.

A particular application is the deposition of plasma-acetylene polymer films which are superhydrophobic coating. To obtain such samples Radio Frequency discharge plasma was generated with the help of two parallel plates as electrodes. Main parameters of the experiment such as power, duration of treatment and gas pressure were established by experimental means and their values are 30W, 3 minutes and 0,5 Torr respectively (Fig. 1). The location of the sample in plasma is also an important variable because the different reaction density in different regions of plasma cloud [1].

Results of study are shown in the Fig. 2: a photo of the samples obtained with the experimental setup showed in the Fig. 1 and a usual photo of the water contact test. With the same parameters for plasma generation we found little differences in the coating depending on the location of the sample inside the plasma, the samples obtained with the experimental setup (b) of the Fig. 1 presents higher hydrophobicity and adhesion to the substrate than the experimental setup (a). Also, the deposition rate and uniformity of the distribution of the coating are different in this two samples, having the sample (b) a very uniform distribution (Fig. 2 b) and a lower deposition rate.

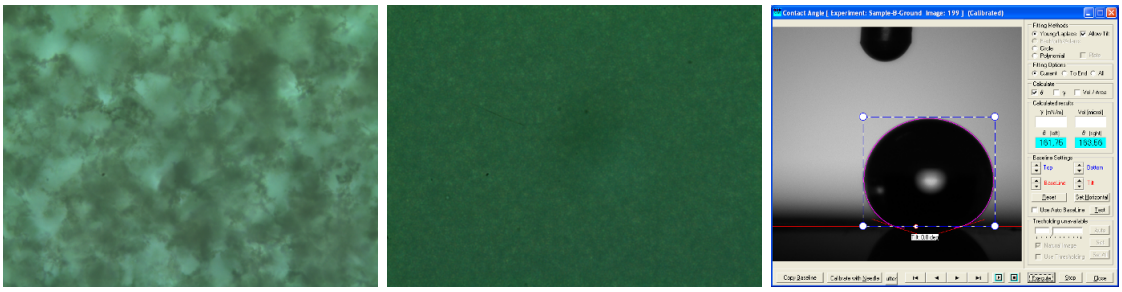
Is possible to make combinations of different gases with acetylene to create a particular polymer, even when this gas does not polymerizes alone. Some authors has made different polymers by combining acetylene with oxygen, nitrogen, water vapor and carbon monoxide. They has found that the color, conductivity, IR spectra, water contact angle and spin concentration is unique for each plasma polymer [2][3].

In conclusion, by changing parameters of the plasma as the pressure or the composition of the gases mixture involved in the plasma reaction we can change the properties of the plasma polymer resulting, adjusting it to the particular needs, either for protective coatings or for biological implants.



(a) (b)

Figure 1: Experimental setup.



(a) Resolution: 20x (b) Resolution: 63x (c) Typical water contact angle

Figure 2: Results.

References

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