

Determination of Surface Free Energy (SFE) by 1 – Click Duo-Drop Technique

Compared to the contact angle (CA) value of a single test liquid, Surface Free Energy (SFE) is in general a more powerful index for characterizing the surface properties regarding wettability and adhesion. This is because more than one test liquid of different chemical properties is involved in the determination of SFE, which allows to gain a more complete picture concerning the spectrum of molecular interactions about the solid surface, especially with regard to dispersive and polar interactions. Not only the sum of SFE but also its components plays an important role in the resulted wetting and adhesion behaviors.

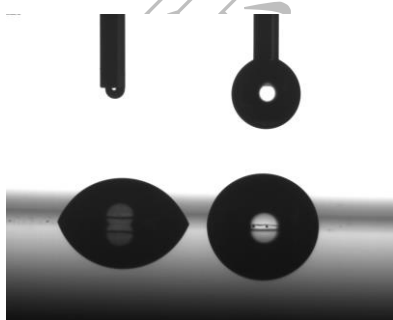
Conventionally, SFE is determined by employing 2 or more (different) test liquids, which are dispensed and measured one after the other in succession. During this procedure, dosing units need to be changed and repositioned, sample surface relocated, dispensing re-invoked, drops re-transferred onto the sample surface, contact angle computation requires to be re-launched, and finally SFE calculation needs to be started, all of these steps require to be repeated, either manually or automatically. Therefore, SFE determination is basically more complex and time-consuming than a single CA measurement.

Now, with the introduction of Duo-Drop (DD) modules, SFE determination can be carried out so simply and fast as a standard measurement of contact angle.

There are two types of Duo-Drop modules available:

- 1) Based on a specially constructed Automatic Double Dispensing Unit (ADDD 30, see the picture on the right);
- 2) Using a bundle of two standard automatic dispensing units (ADDU 30/ADUV 30).

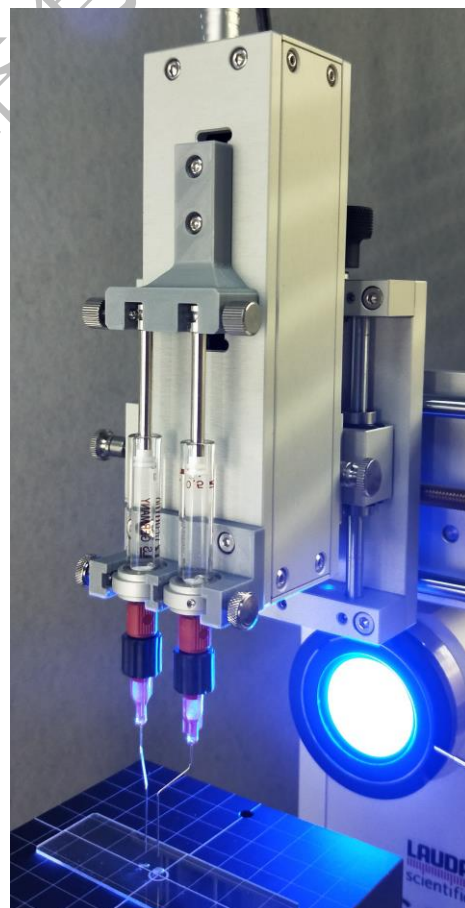
An ADDD 30 unit can be equipped with up to two precision glass syringes of the same or different sizes, in which two different test liquids can be filled. Consequently, two drops from each of the two syringes, with same or different volumes, can be dispensed and formed (see the picture below), brought onto the sample surface, and measured, all at the same time, respectively. From the contact angle values determined for the two different liquids, SFE can be computed straightaway based on the computation method set previously.



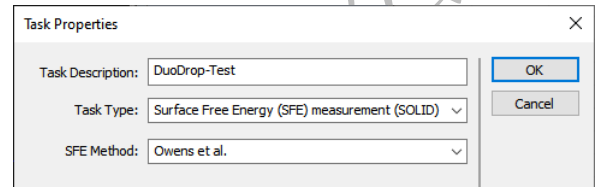
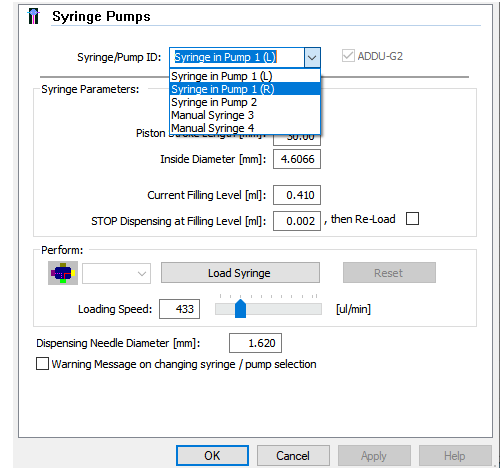
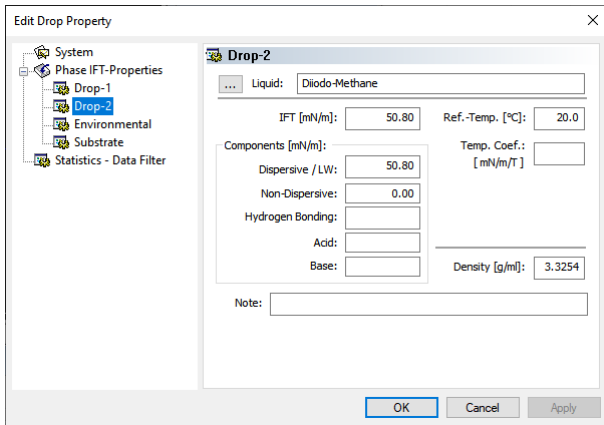
The same measurement procedure can be also realized by bundling up two standard automatic dispensing units, either 2X ADDU 30 or 2X ADUV 30 or mixed, into a DUO-group.

Before starting measurement, properties of syringes and test liquids filled in each syringe and the method that is to be used later for evaluating SFE can be set up (ref. pictures 3-5). Then just

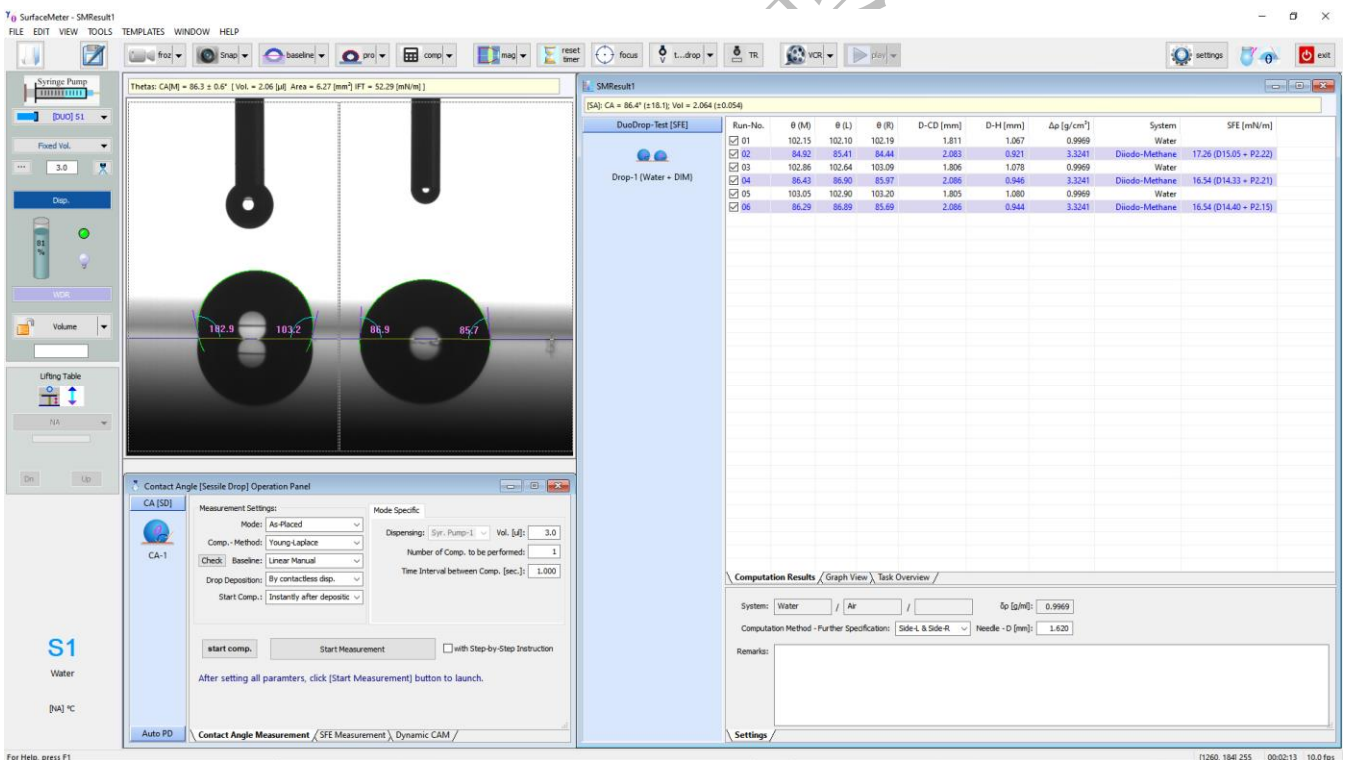
follow the way, in which a typical CA measurement of a single test liquid is carried out: dispensing, transferring the drop(s) onto the sample surface and invoking computation. At the last step, you get the results of CA-measurement for two test liquids, and in addition, you get the value of SFE (see picture 6). All the steps mentioned above may



be, of course, further automated, just as in the case of a contact angle measurement: Non-Contacting dispensing feature or automatic sample stage Z-axis module may be employed to automate the drop deposition step, computation may be triggered automatically after the drops have been transferred onto the sample surface, sample may be moved to a new location for the next measurement automatically, etc.



Pictures 3 (top right), 4 (bottom left) and 5 (bottom right): Settings of Syringes, drops and Task



Picture 6: measurement and results

Furthermore, there are a number of distinct features, which set ourselves apart from the competition:

- The gap between two drops can be adjusted flexibly, which allows measurement with drops of a wide range of sizes to be performed, from sub-microliters up to teen microliters (µl);
- ADDD 30 can be fitted with a switchable unique Non-contacting dispensing (NCD) capability;
- ADDD 30 can be used just as a standard dispensing unit when equipped with only one syringe.