

15.th Repetition - changing speed modes

ID N° 22513 - Contact Angle Measurement - M4^a

Cu-Stab (A15)

• Kupfer / Isooktan 99.5+% : (20,0°C, 0,38', 21mm, 1,85mm/s - accelerated; θ -asymm.)

$\theta_{M,a}$ (no angle), ${}^a\bar{E}_a = 24,52_{\pm 0,31}$ mN/m aH_a 56,95mN/m, $\bar{B}_{\%,a} = 130,7\%$

Report

1. ===== Introduction =====

Principle: The contact angle measurement using the 'Wilhelmy method' is based on force measurements on a cuboid or cylindrical solid body brought into contact with a liquid surface. The contact line between the solid, the liquid surface, and the gas phase is called the three-phase boundary line (triple line), and the angle at which the liquid surface meets the three-phase boundary line is the contact angle θ (theta). The relative position of the three-phase boundary line-above, on, or below the surrounding liquid level-reflects the surface energy characteristics and is indicated by the resulting curvature of the meniscus. The weight of this meniscus curvature is determined gravimetrically, taking buoyancy forces into account, and is related to the length of the three-phase boundary line. With perfect wetting ($\theta=0^\circ$), this specific force reaches a maximum value, which corresponds to the surface tension of the liquid; with poor wettability ($\theta>90^\circ$), however, this wetting force becomes negative. Energetic interactions between the solid and liquid phases are thus made visible through the contact angle (normally). When the solid body is immersed, the triple line scans the solid surface, yielding the advancing contact angle (θ_A), and when it is withdrawn, the receding contact angle (θ_R) is obtained - measured by force of wetting. The difference ' $\theta_A-\theta_R$ ' is called the contact angle hysteresis (CAH).

Physically: The Wilhelmy equation $\cos\theta_{(A|R)} = {}^aF / (p \cdot \gamma)$ describes the relationship between the contact angle θ , the perimeter of the solid p , the wetting force aF , and the surface tension of the liquid γ . Adhesion tension aE is defined according ${}^aE_{A,R} = m_{meniscus}g/p = {}^aF/p = \gamma \cdot \cos\theta = \gamma_s - \gamma_{sl}$

Practically: In this measurement, after the position of contact of liquid and solid has been determined, the 'Kupfer' test specimen is moved into and out of the Isooktan 99.5+% liquid with a linear acceleration. This allows the determination of accelerated contact angles or rather of adhesion energy aE . While for each of the selected 6 accel. measurements, the respective contact angle θ_A or θ_R is calculated independently. As relative wettability ($B_{\%}$) exceeds the mark +100% this measurement may indicate occurrence of super-wetting, where adhesion energy aE enables further analysis. Moreover the occurrence of an inverted contact-angle hysteresis must be mentioned.

Information: The IMETER M4 method description, available at <https://imeter.de/?view=article&id=46>, provides information on procedures and calculations. Autogener Prüfbericht mit Erklärungen. Diese sind formatiert wie dieser Text.

2. ===== Collection of Measurements in this Series Kupfer / Isooktan 99.5+% =====

Tabelle 1.2: Conditions and Results

N°	IDN° ...erData39	θ [°C]	$\Delta\tau$ [min]	\bar{v}_z [mm/s]	$\bar{C}a$ [1]	$t_{eq.}$ [s]	θ_M [°]	CAH [°]	aH [mN/m]	${}^a\bar{E}$ [mN/m]	$\pm\sigma$ [mN/m]	\bar{S} [m/m²]	$\bar{B}_{\%,Isookta...}$ [%]
1.	22498 ₀	20,01	-86,5	»0,0456«	-	3,08	<0>	<0>	0,043	19,733	±0,071	0,983	105,2%
2.	22499 ₁	20,008	-62,9	10,0	2,65E-4	5,5	<90>	<-180>	80,56	20,3	±1,3	1,55	108,2%
3.	22500 ₂	20,01	-62,0	5,00	1,32E-4	5,3	<45>	<-89>	40,59	20,75	±0,66	2,00	110,6%
4.	22501 ₃	20,021	-61,0	2,50	6,61E-5	5,3	<53>	<-110>	52,05	20,77	±0,33	2,02	110,7%
5.	22502 ₄	20,022	-59,8	1,25	3,31E-5	5,3	<33>	<-66>	26,48	20,88	±0,18	2,13	111,4%
6.	22503 ₅	20,022	-58,4	0,625	1,65E-5	5,3	<20>	<-41>	13,09	20,79	±0,16	2,04	110,9%
7.	22504 ₆	20,006	-56,2	0,31	8,27E-6	6,1	<0>	<0>	6,836	23,996	±0,077	5,25	128,0%
8.	22505 ₇	20,01	-21,8	0,156	4,13E-6	0,7	<0>	<0>	3,474	23,49	±0,12	4,74	125,3%
9.	22506 ₈	20,009	-16,1	<0,957>	2,53E-5	5,0	<22>	<-45>	21,55	24,09	±0,20	5,34	128,5%
10.	22507 ₉	20,012	-14,5	<0,710>	1,87E-5	5,3	<22>	<-45>	21,59	24,12	±0,19	5,37	128,6%
11.	22508 ₁₀	20,011	-12,6	<0,318>	8,43E-6	6,6	<12>	<-25>	13,533	23,80	±0,18	5,05	127,0%
12.	22509 ₁₁	20,008	-9,60	<0,357>*	9,42E-6	5,6	<0,05>	<-0,1>	9,721	24,89	±0,13	6,14	132,7%
13.	22510 ₁₂	20,003	-6,50	<0,422>*	1,11E-5	5,7	<9>	<-18>	13,22	24,33	±0,25	5,58	129,8%
14.	22511 ₁₃	20,006	-3,92	<0,392>*	1,04E-5	6,4	<12>	<-24>	14,097	24,06	±0,11	5,31	128,3%
15.	22512 ₁₄	20,006	-1,25	<1,69>*	4,46E-5	5,7	<52>	<-100>	56,7	24,248	±0,060	5,50	129,3%
16.	22513 ₁₅	20,006	0,00	<1,93>*	5,10E-5	5,5	<51>	<-100>	56,95	24,52	±0,31	5,77	130,7%
17.	22514 ₁₆	20,007	+1,25	<2,55>*	6,74E-5	5,2	<51>	<-100>	56,00	23,87	±0,19	5,12	127,3%
18.	22515 ₁₇	20,01	+2,35	<4,43>*	1,17E-4	5,1	<52>	<-100>	60,6	25,69	±0,20	6,94	137,0%
19.	22516 ₁₈	20,01	+3,35	<6,70>	1,77E-4	5,1	<90>	<-180>	98,7	22,5	±3,3	3,75	119,7%
20.	22517 ₁₉	20,01	+4,27	»0,045«	-	3,15	<0>	<0>	0,345	23,958	±0,068	5,21	127,8%
21.	22518 ₂₀	20,01	+22,2	»0,0448«	-	3,13	<0>	<0>	0,101	23,646	±0,083	4,90	126,1%

This table provides an overview of the measurements in this series. Each separate M4 measurement is referenced by IDN°. The highlighted row indicates the data set of the measurement documented below. The column labeled θ shows the measurement temperature, $\Delta\tau$ the time interval to previous/following measurements, \bar{v}_z the movement speed - where additional symbols clarify: »« indicates static measurements, <n> represents distance-accelerated movement of the triple line, '*' stands for continuous acceleration and a number without any symbol indicates a constant movement speed, $\bar{C}a$ is the capillary number, $t_{eq.}$ is the equilibration time before turnaround - but for static measurements the number denotes the average equilibration time between the measurement points, θ_M is the mean of the advancing and receding contact angle (<n>' signs errors), contact angle hysteresis is given in degrees (CAH) and in energy units (aH), ${}^a\bar{E}$ is the mean adhesion energy, and $\pm\sigma$ is the corresponding standard deviation, \bar{S} is the mean of the spreading parameter, and $\bar{B}_{\%,Isookta...}$ indicates the relative wettability ($B_{\%,Iq|sl|md...} = 100\% \cdot {}^aE/\gamma$).

Tabelle 2.2: Summary of sample weights in the individual measurements (initial weight $W_0 = 24,6678$ g)

N°	W_A [g]	ΔW_{A-0} [mg]	W_E [g]	ΔW_{E-0} [mg]	V_{E-0} [µL]	ΔV_{E-A} [µL]
1.	24,6678	0,0	24,6763	8,5	12,3	12
2.	24,6764	8,6	24,6802	12,4	17,9	5,6
3.	24,6800	12,2	24,6775	9,7	14,0	-3,9
4.	24,6773	9,5	24,6758	8,0	11,6	-2,5
5.	24,6755	7,7	24,6746	6,8	9,8	-1,7
6.	24,6745	6,7	24,6738	6,0	8,7	-1,2
7.	24,6738	6,0	24,6736	5,8	8,4	-0,29
8.	24,6736	5,8	24,6733	5,5	7,9	-0,43
9.	24,6734	5,6	24,6746	6,8	9,8	1,9
10.	24,6745	6,7	24,6741	6,3	9,1	-0,72
11.	24,6740	6,2	24,6735	5,7	8,2	-0,87
12.	24,6734	5,6	24,6733	5,5	7,9	-0,29
13.	24,6733	5,5	24,6742	6,4	9,2	1,3
14.	24,6742	6,4	24,6742	6,4	9,2	~0
15.	24,6741	6,3	24,6764	8,6	12,4	3,2
16.	24,6763	8,5	24,6767	8,9	12,9	0,43
17.	24,6766	8,8	24,6775	9,7	14,0	1,2
18.	24,6773	9,5	24,6796	11,8	17,1	3,0
19.	24,6794	11,6	24,6779	10,1	14,6	-2,5
20.	24,6778	10,0	24,6763	8,5	12,3	-2,3
21.	24,6764	8,6	24,6731	5,3	7,7	-4,6

Symbols: W_A : Total weight before each measurement, ΔW_{A-0} : Change in weight from the initial weight W_0 at the start of the series, W_E : Total weight after the measurement (possibly including the weight of any adherent fluid), ΔW_{E-0} : Change in weight from the initial weight W_0 at the start of the series, V_{E-0} : Weight change interpreted as fluid volume, ΔV_{E-A} : Fluid volume change calculated

3. ===== Measurement IDN°22513: Accelerated Contact Angle =====

Kupfer, cylindric Ø7,971mm

20mm Kupfer \ Isooktan 99.5+%, $\gamma = 18,75 \text{ mN/m}$ $\vartheta = 20,0^\circ \text{C}$

Contact Angle, CA $\theta_{M,d}$	<51 ±0,5°>	asymmetric	
Contact Angle Hysteresis, CAH_a	<-100°>	inverted	
	Advancing θ_A	Receding θ_R	Transition - mm
Contact Angles, θ_a	<0°>	<102,2°>	0° _{adv.} ⇒ 0° _{rec.}
Rated measurements n mm-range	3 11,793 - 12,243mm	3 9,295 - 8,960mm	16 20,938 - 20,838mm
Platform speed \bar{v}_z [mm/s]	1,8520 ±1,9E-4	-2,0060 ±2,0E-4	
Capillary number Ca	4,90E-5	-5,31E-5	
Linear accelerated a_z [mm/s²]	0,3430 10,799 sec ...	-0,3430 11,697 seconds applied	
acceleration path s_a [mm]	20,810	-24,342	
Speed at Position $v@$ [mm/s]	2,82 12,018mm	-2,80 9,128mm	
Capillary number $Ca@$	7,46E-5	-7,40E-5	
max. Speed v_{zmax} [mm/s]	3,70	-4,01	

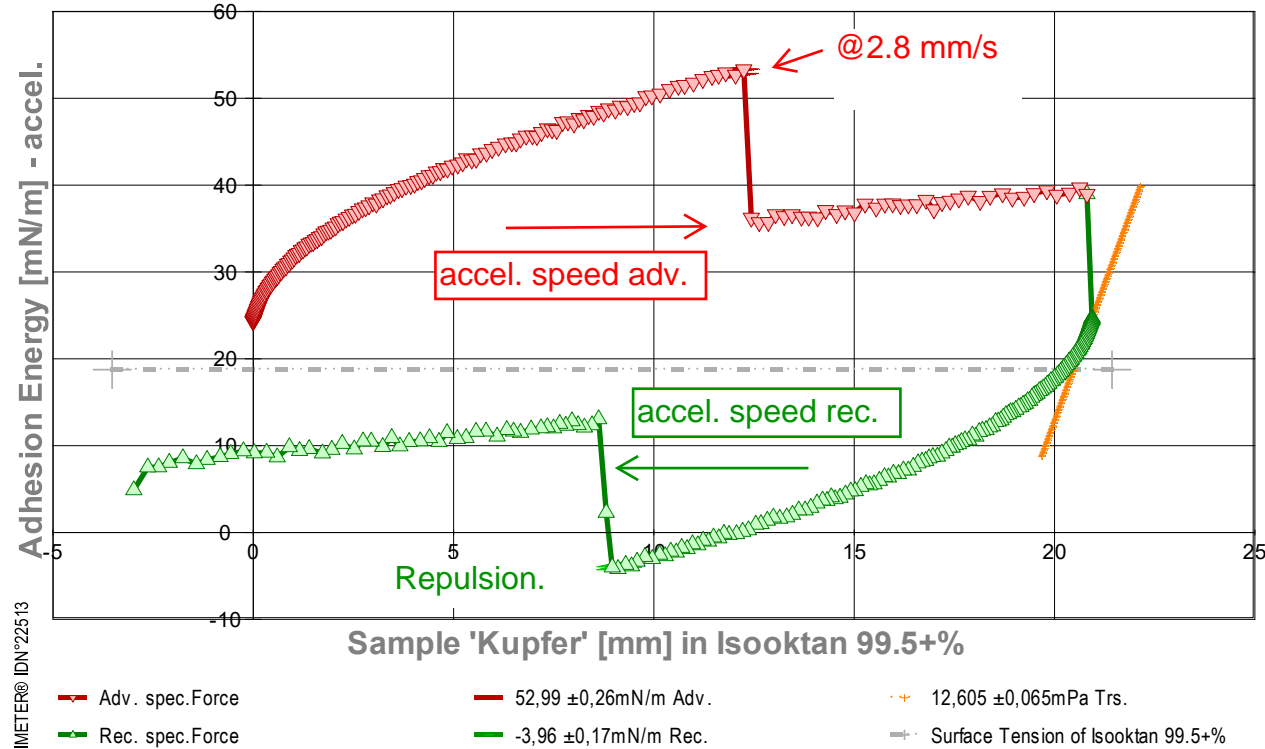
Dynamic Contact Angle Measurement: Asymmetric advancing - receding - consider adhesion parameters for analysis. Accountable deposit layer according to Derjaguin's Law solves for $v@$ with $e \sim 0,014 \text{ mm}$. A capillary number Ca below $\sim 10^{-5}$ is an indication for the predominance of capillary forces over viscous drag in porous media! The change of the direction from advancing to receding - where the triple line may be pinned and only the angle is changing from advancing to receding - is analyzed within the column "Transition". no CA-Diagramm why?

Adhesion Force of the accelerated Triple Line

Energy of Adhesion, ${}^a\bar{E}_a = ({}^aE_A + {}^aE_R) / 2$	24,52 ±0,31 mN/m
Hysteresis, ${}^aH_a = {}^aE_A - {}^aE_R$	56,95 mN/m
Parameter of spreading, $S_a = {}^a\bar{E} - \gamma$	5,77 mJ/m ²
relative wettability, $\bar{B}_{\%,a} = 100 \cdot {}^a\bar{E} / \gamma$	130,7% with Isooktan 99.5+%

	Advancing aE_A	Receding aE_R	Transition - mm
Energy of Adhesion, aE [mN/m]	52,99	-3,96	24,44<adv.> ⇒ 23,40 rec.
Standard deviation ${}^a\sigma$ [mN/m]	±0,26	±0,17	±0,065
Linear regression, slope [mPa]	0,71	0,97	12,605
correlation coefficient r^2	0,27	0,47	0,976
Relative wettability, $B_{\%}$	282,6%	-21,12%	

→ Diagramm 1.3: 'Triple-line Force²' dynamic forces at the triple line, $\bar{v}_z = 1,9 \text{ mm/s}$



Das Diagramm zeigt den Verlauf der Adhäsionsenergie aE entlang der Probenoberfläche. Die Messstrecke ist konstant beschleunigt mit 35 ppm des normalen Ortsfaktors (9.81m/s²). Die roten ∇ -Markierungen stehen für adv.-Messwerte (Eintauchen; von links nach rechts aufgezeichnet), grüne Δ -Markierungen gehören zu rec.-Werten (Rückzugsbewegung; von rechts nach links laufend). Die Oberflächenspannung von Isooktan 99.5+% ist als grau gestrichelte Horizontale bei 18,75 mN/m eingezeichnet; sie gibt die maximale Zugfestigkeit an, die eine flüssige Isooktan 99.5+%-Oberfläche aushalten kann. Es zeigt sich, die Adhäsionsenergie zwischen Isooktan 99.5+% und Kupfer übersteigt teilweise die Oberflächenspannung. Diese Überbenetzung (Superwetting) ist gekennzeichnet durch die hier einseitige Kontaktwinkelproblematik, da $\cos(\theta) > 1$ auftritt. Wenn andere Störeinflüsse (z.B. elektrostatische, rheologische) auszuschließen sind, kommen Grenzschicht-Effekte in Betracht, die den lokalen Wert der Oberflächenspannung an der Triple Line raumgreifend steigern oder tribologische Effekte das Geschehen verändern könnten.

4. ===== Details on the Measurement and Setup =====

This document is reporting the **15. Repetition of the Measurement IDN°22498**

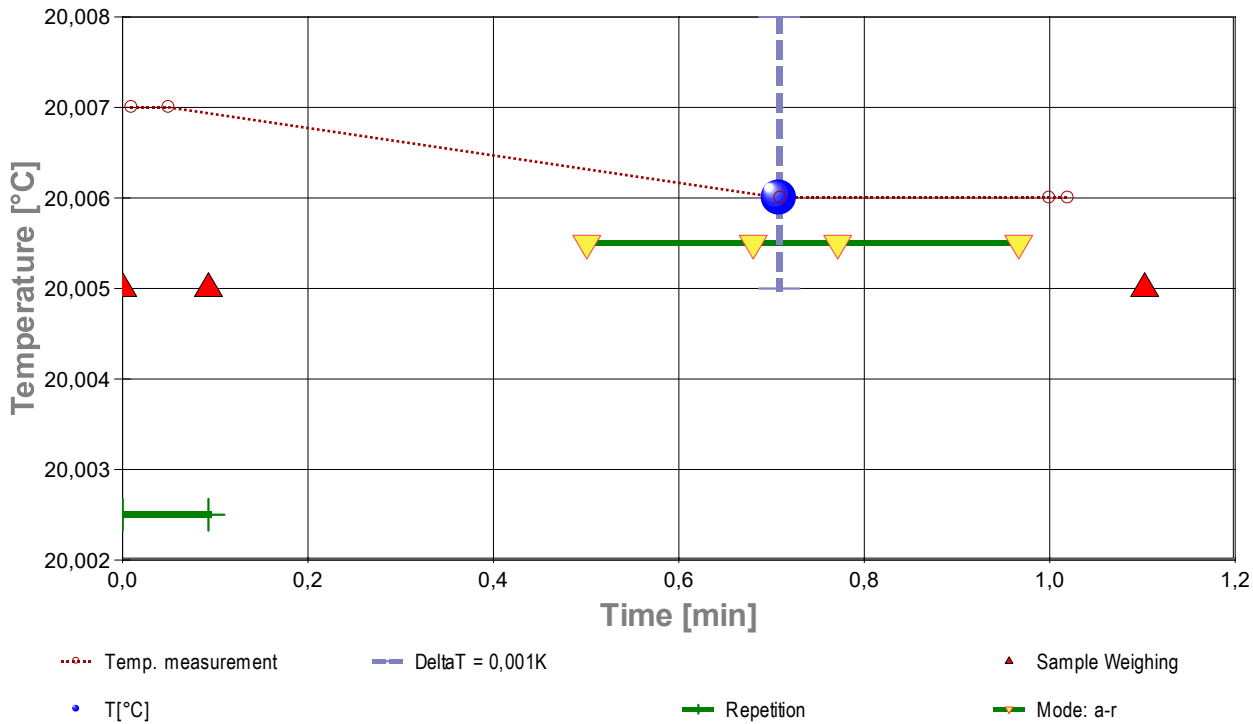
- Details of the setup, data on liquid and sample of this IDN°22513 are declared in the first measurement that is IDN°22498 of this series.

Weight at Start: 24,6763 g; alteration to reference 0,0085 g.

Measurement algorithm: dynamic CA-measurement, acquisition during constant accelerated movement, not reaching a constant speed. Maximum immersion of 20,104 mm and force equilibration at the inflection point for 5,5 s. Positions geometrical corrected - e.g. for 0,706 mm at max immersion to 20,810 mm. Duration for immersion 11 s, for emersion 12 s.

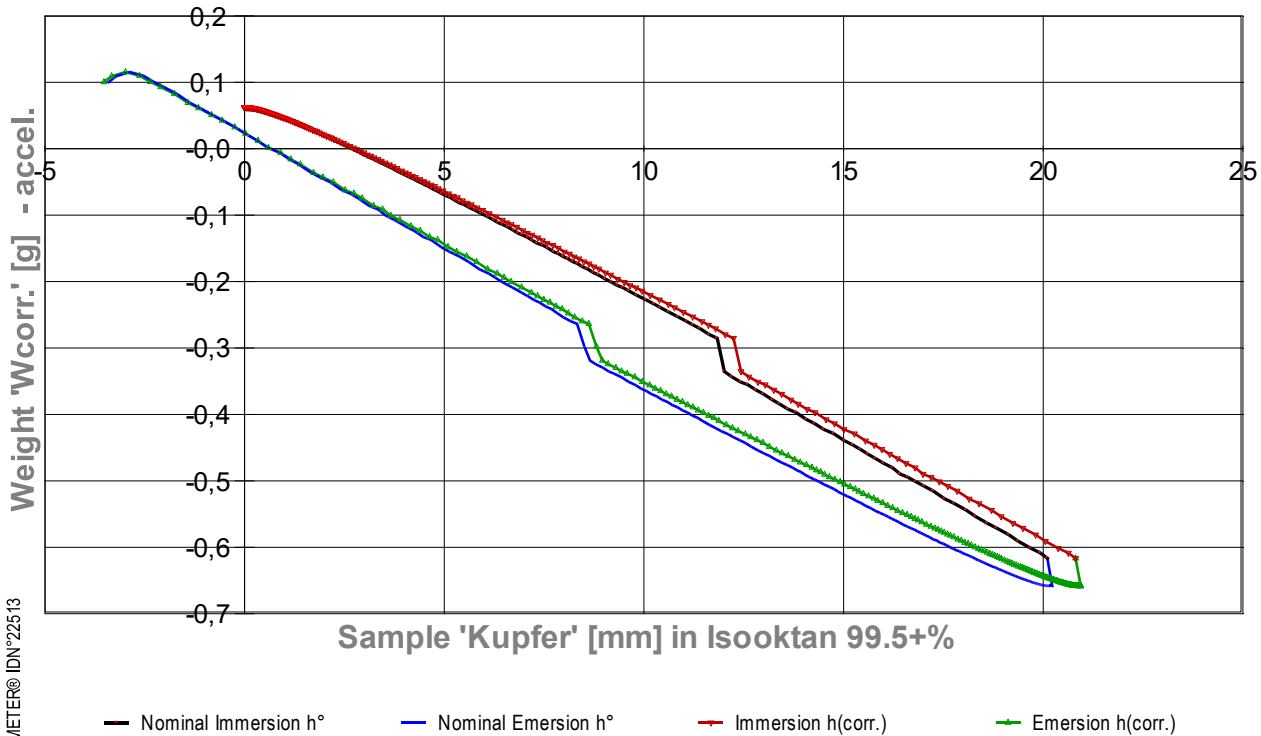
Time & Temperature: Messdauer eine Minute; Temperaturverlauf blieb im gesamten Zeitraum exakt isotherm bei 20,006°C.

- Diagramm 2.4: 'Temperature & Events²' -- Survey on Temperature and Time



- Das Diagramm "Temperature & Events²" dokumentiert neben der Flüssigkeitstemperatur der Messfluids (Isooktan 99,5+%) die zeitliche Abfolge der Verfahrensschritte. Die Temperaturmesswerte sind als kleine Kreise abgebildet; die kugelförmige Marke gibt die der Messung insgesamt zugeordnete Temperatur an (20,006°C). Weitere gelbe Dreiecke auf der grünen Horizontalen bezeichnen die Schaltung jeweiliger Messmodi ('a-r' bedeutet *Advancing*- und *Receding*-Bewegung). Die roten Dreiecke, unten im Diagramm, markieren die Zeitpunkte der Probenwägung von Kupfer (ohne Kontakt zur Fluidoberfläche).

- Diagramm 3.4: 'RawData²' -- Acquired weights during immersion and emersion (raw data and immersion corrected lengths)



- Im Diagramm "RawData²" werden die Wägewerte zur dynamischen Kontaktwinkelmessung gegen die Eintauchtiefe der Probe abgebildet. Von den Roh-Wägewerten W_{RAW} wurden Proben- und Aufhängungsgewichte subtrahiert, so dass hier die *Gewichte* der Benetzungs- und Auftriebskräfte abgebildet werden ($W_{corr.}$). Die Kurvenverläufe fallen mit der Eintauchtiefe h (*immersion depth*) ab, indes der Volumenauftrieb des eintauchenden Probekörpers zunimmt. Im Diagramm sind Wägewerte für die advancing- und receding-Bewegung eingetragen, sowohl für nominelle (h_0) und für korrigierte Eintauchtiefen ($h_{corr.}$). Die roten Dreiecke bezeichnen die Messwerte bei $h_{corr.}$ bei der Vorwärtsbewegung (adv.), die grünen Dreiecke gehören zu Auszugsbewegungen (rec.). Bei korrigierten Werten $h_{corr.}$ werden Pegeländerungen durch das Ein/Austauschende Volumen der Probe berechnet und berücksichtigt. Weiterhin zeigt das Diagramm noch Werte zu *negativen Eintauchtiefen*. Diese Wertepaare gehören der *Kapillarbrücke* ($cb = capillary bridge$) an, die sich beim Herausziehen der Probe über das Flüssigkeitsniveau deutlich ausbilden kann; besonders, wenn das Probenende scharfkantig ist.

5. ===== Table of raw data and results =====

The table below provides the data for each measuring position in this experiment ($n=388$). Within a row the column t lists the time of the CA-measurement. $v(t)$ is the actual speed of immersion/emersion. The nominal distance between the sample bottom flatface and the liquid surface is given by h_0 , whilst $h_{corr.}$ shows the corrected immersion depth. The sum of calculated dynamic forces are taken into account by $F_{dyn.}$. The $W_{corr.}$ -values are the original raw weighing values when the weight of the dry sample and its holder ($W_0=24,6678g$) is subtracted. aF is the corrected force exerted on the triple line. The Energy of Adhesion ${}^aE_{A,R} = {}^aF/p$ is the force of adhesion per meter of the circumference (p) of the sample. θ is the Contact Angle (CA). The last column indicates by **chr** the advancing resp. receding state; **cb** tags values of the 'capillary bridge'.

$$({}^aF = (W_{raw} - W_0 - W_{Buoy.}) \cdot g + F_{Buoy.air} - F_{visc.} - F_{kinet.} - F_{work} = (W_{corr.} - W_{Buoy.}) \cdot g - F_{dyn.}$$

Table 3.5: Data table

N°	t [sec]	$v(t)$ [mm/s]	h_0 [mm]	$h_{corr.}$ [mm]	$F_{dyn.}$ [mN]	$W_{corr.}$ [g]	aF [mN]	${}^aE_{A,R}$ [mN/m]	θ [°deg]	chr
1.	0,00	0,00	0,001	-0,006	0	0,0623	0,6091	24,32	0	a
2.	0,05	0,0161	0,002	-0,004	6,61E-5	0,0623	0,6095	24,34	0	a
3.	0,09	0,0305	0,004	-0,002	6,62E-5	0,0623	0,6102	24,37	0	a
4.	0,13	0,0453	0,006	0,000	6,62E-5	0,0623	0,6111	24,40	0	a
5.	0,18	0,0624	0,010	0,004	6,63E-5	0,0623	0,6124	24,46	0	a
6.	0,23	0,0796	0,015	0,009	6,65E-5	0,0623	0,6141	24,52	0	a
7.	0,28	0,0971	0,021	0,015	6,66E-5	0,0623	0,6160	24,60	0	a
8.	0,33	0,114	0,027	0,021	6,68E-5	0,0623	0,6181	24,68	0	a
9.	0,38	0,131	0,034	0,029	6,70E-5	0,0622	0,6197	24,75	0	a
10.	0,43	0,148	0,042	0,037	6,72E-5	0,0622	0,6225	24,86	0	a
11.	0,48	0,166	0,051	0,047	6,75E-5	0,0622	0,6257	24,99	0	a
12.	0,53	0,183	0,061	0,057	6,78E-5	0,0622	0,6291	25,12	0	a
13.	0,58	0,200	0,072	0,068	6,81E-5	0,0621	0,6318	25,23	0	a
14.	0,63	0,217	0,083	0,080	6,84E-5	0,0621	0,6358	25,39	0	a
15.	0,69	0,235	0,096	0,093	6,87E-5	0,0621	0,6403	25,57	0	a
16.	0,73	0,252	0,109	0,107	6,91E-5	0,0620	0,6440	25,72	0	a
17.	0,79	0,269	0,123	0,121	6,95E-5	0,0620	0,6489	25,91	0	a
18.	0,84	0,286	0,138	0,136	6,99E-5	0,0619	0,6531	26,08	0	a
19.	0,89	0,304	0,154	0,153	7,04E-5	0,0618	0,6576	26,26	0	a
20.	0,94	0,321	0,171	0,170	7,08E-5	0,0617	0,6625	26,46	0	a
21.	0,99	0,338	0,189	0,189	7,13E-5	0,0615	0,6667	26,62	0	a
22.	1,04	0,355	0,207	0,208	7,19E-5	0,0613	0,6713	26,81	0	a
23.	1,09	0,373	0,227	0,228	7,24E-5	0,0611	0,6762	27,00	0	a
24.	1,14	0,390	0,247	0,249	7,30E-5	0,0608	0,6801	27,16	0	a
25.	1,19	0,407	0,268	0,271	7,36E-5	0,0606	0,6856	27,38	0	a
26.	1,24	0,424	0,290	0,293	7,42E-5	0,0602	0,6893	27,53	0	a
27.	1,29	0,442	0,313	0,317	7,48E-5	0,0600	0,6955	27,77	0	a
28.	1,34	0,459	0,336	0,341	7,55E-5	0,0595	0,6987	27,90	0	a
29.	1,39	0,476	0,361	0,367	7,62E-5	0,0592	0,7043	28,13	0	a
30.	1,44	0,494	0,386	0,393	7,69E-5	0,0587	0,7083	28,28	0	a
31.	1,49	0,510	0,413	0,420	7,76E-5	0,0583	0,7135	28,49	0	a
32.	1,54	0,528	0,440	0,448	7,84E-5	0,0577	0,7172	28,64	0	a
33.	1,59	0,545	0,468	0,477	7,92E-5	0,0573	0,7230	28,87	0	a
34.	1,64	0,562	0,497	0,507	8,00E-5	0,0566	0,7262	29,00	0	a
35.	1,69	0,580	0,527	0,538	8,09E-5	0,0561	0,7317	29,22	0	a
36.	1,74	0,597	0,558	0,571	8,17E-5	0,0554	0,7359	29,39	0	a
37.	1,79	0,615	0,590	0,603	8,26E-5	0,0546	0,7390	29,51	0	a
38.	1,84	0,631	0,621	0,636	8,35E-5	0,0540	0,7441	29,71	0	a
39.	1,89	0,648	0,654	0,670	8,44E-5	0,0535	0,7507	29,98	0	a
40.	1,94	0,666	0,688	0,705	8,54E-5	0,0526	0,7538	30,10	0	a
41.	1,99	0,683	0,723	0,741	8,64E-5	0,0520	0,7601	30,36	0	a
42.	2,04	0,700	0,759	0,779	8,74E-5	0,0511	0,7639	30,50	0	a
43.	2,09	0,718	0,796	0,816	8,84E-5	0,0501	0,7668	30,62	0	a
44.	2,14	0,735	0,834	0,855	8,95E-5	0,0495	0,7741	30,91	0	a
45.	2,19	0,752	0,872	0,895	9,06E-5	0,0484	0,7768	31,02	0	a
46.	2,24	0,769	0,912	0,936	9,17E-5	0,0477	0,7836	31,29	0	a
47.	2,29	0,786	0,952	0,977	9,28E-5	0,0466	0,7869	31,42	0	a
48.	2,34	0,803	0,991	1,018	9,39E-5	0,0458	0,7927	31,66	0	a
49.	2,39	0,820	1,033	1,061	9,51E-5	0,0450	0,7995	31,93	0	a
50.	2,44	0,838	1,077	1,107	9,63E-5	0,0438	0,8032	32,07	0	a
51.	2,49	0,855	1,121	1,153	9,76E-5	0,0425	0,8058	32,18	0	a
52.	2,54	0,873	1,166	1,200	9,88E-5	0,0417	0,8137	32,50	0	a
53.	2,60	0,890	1,212	1,246	1,00E-4	0,0403	0,8158	32,58	0	a
54.	2,64	0,906	1,254	1,290	1,01E-4	0,0394	0,8218	32,82	0	a
55.	2,69	0,923	1,301	1,339	1,03E-4	0,0380	0,8245	32,93	0	a
56.	2,74	0,941	1,351	1,390	1,04E-4	0,0370	0,8321	33,23	0	a
57.	2,80	0,959	1,403	1,444	1,05E-4	0,0355	0,8355	33,37	0	a
58.	2,85	0,977	1,451	1,495	1,07E-4	0,0339	0,8368	33,42	0	a
59.	2,90	0,993	1,501	1,546	1,08E-4	0,0328	0,8433	33,67	0	a
60.	2,95	1,01	1,552	1,599	1,10E-4	0,0312	0,8456	33,77	0	a
61.	2,99	1,03	1,601	1,649	1,11E-4	0,0301	0,8517	34,01	0	a
62.	3,05	1,05	1,658	1,708	1,13E-4	0,0283	0,8539	34,10	0	a
63.	3,10	1,06	1,712	1,764	1,14E-4	0,0272	0,8620	34,42	0	a
64.	3,14	1,08	1,762	1,816	1,16E-4	0,0260	0,8679	34,66	0	a
65.	3,19	1,10	1,818	1,874	1,17E-4	0,0242	0,8698	34,73	0	a
66.	3,25	1,11	1,879	1,937	1,19E-4	0,0223	0,8724	34,84	0	a
67.	3,29	1,13	1,932	1,992	1,20E-4	0,0211	0,8791	35,10	0	a
68.	3,34	1,15	1,993	2,055	1,22E-4	0,0192	0,8819	35,22	0	a
69.	3,40	1,17	2,057	2,121	1,24E-4	0,0179	0,8913	35,59	0	a
70.	3,44	1,18	2,109	2,175	1,25E-4	0,0165	0,8958	35,77	0	a
71.	3,49	1,20	2,170	2,238	1,27E-4	0,0145	0,8975	35,84	0	a
72.	3,56	1,22	2,247	2,318	1,29E-4	0,0125	0,9047	36,13	0	a
73.	3,62	1,24	2,320	2,393	1,31E-4	0,0104	0,9095	36,32	0	a
74.	3,68	1,26	2,401	2,477	1,34E-4	0,0082	0,9165	36,60	0	a
75.	3,73	1,28	2,469	2,547	1,35E-4	0,0060	0,9185	36,68	0	a
76.	3,79	1,30	2,554	2,636	1,38E-4	0,0038	0,9268	37,01	0	a
77.	3,86	1,32	2,640	2,724	1,40E-4	0,0015	0,9341	37,30	0	a
78.	3,92	1,34	2,716	2,803	1,42E-4	-0,0009	0,9370	37,42	0	a
79.	3,98	1,37	2,800	2,890	1,45E-4	-0,0033	0,9429	37,65	0	a
80.	4,04	1,39	2,892	2,985	1,47E-4	-0,0057	0,9516	38,00	0	a
81.	4,10	1,41	2,975	3,071	1,50E-4	-0,0090	0,9480	37,86	0	a
82.	4,16	1,43	3,056	3,155	1,52E-4	-0,0107	0,9599	38,33	0	a
83.	4,21	1,45	3,135	3,237	1,54E-4	-0,0132	0,9629	38,45	0	a

84.	4.28	1.47	3,234	3,339	1,57E-4	-0,0158	0,9719	38,81	0	a
85.	4.33	1.49	3,314	3,422	1,59E-4	-0,0184	0,9743	38,91	0	a
86.	4.40	1.51	3,409	3,520	1,62E-4	-0,0211	0,9812	39,18	0	a
87.	4.46	1.53	3,511	3,625	1,65E-4	-0,0238	0,9901	39,54	0	a
88.	4.52	1.55	3,596	3,714	1,67E-4	-0,0266	0,9924	39,63	0	a
89.	4.59	1.57	3,693	3,814	1,70E-4	-0,0293	0,9998	39,93	0	a
90.	4.65	1.59	3,804	3,930	1,73E-4	-0,0331	1,0016	40,00	0	a
91.	4.70	1.61	3,897	4,025	1,76E-4	-0,0360	1,0053	40,14	0	a
92.	4.75	1.63	3,975	4,106	1,78E-4	-0,0380	1,0131	40,46	0	a
93.	4.81	1.65	4,065	4,199	1,80E-4	-0,0410	1,0150	40,53	0	a
94.	4.85	1.66	4,140	4,277	1,83E-4	-0,0430	1,0218	40,80	0	a
95.	4.92	1.69	4,247	4,388	1,86E-4	-0,0460	1,0297	41,12	0	a
96.	4.97	1.70	4,337	4,481	1,88E-4	-0,0491	1,0307	41,16	0	a
97.	5.02	1.72	4,424	4,571	1,91E-4	-0,0512	1,0405	41,55	0	a
98.	5.07	1.74	4,516	4,666	1,93E-4	-0,0544	1,0413	41,58	0	a
99.	5.12	1.76	4,601	4,754	1,95E-4	-0,0565	1,0503	41,94	0	a
100.	5.17	1.77	4,690	4,846	1,98E-4	-0,0598	1,0491	41,89	0	a
101.	5.23	1.79	4,806	4,967	2,01E-4	-0,0631	1,0574	42,22	0	a
102.	5.30	1.82	4,939	5,104	2,05E-4	-0,0675	1,0606	42,36	0	a
103.	5.37	1.84	5,055	5,224	2,08E-4	-0,0710	1,0668	42,60	0	a
104.	5.42	1.86	5,153	5,326	2,11E-4	-0,0733	1,0785	43,07	0	a
105.	5.49	1.88	5,275	5,452	2,14E-4	-0,0780	1,0751	42,93	0	a
106.	5.54	1.90	5,383	5,563	2,17E-4	-0,0816	1,0772	43,02	0	a
107.	5.61	1.92	5,492	5,676	2,21E-4	-0,0839	1,0928	43,64	0	a
108.	5.67	1.94	5,633	5,822	2,25E-4	-0,0887	1,0949	43,72	0	a
109.	5.73	1.97	5,766	5,960	2,28E-4	-0,0924	1,1053	44,14	0	a
110.	5.82	2.00	5,923	6,122	2,33E-4	-0,0973	1,1118	44,40	0	a
111.	5.91	2.03	6,090	6,295	2,37E-4	-0,1023	1,1214	44,78	0	a
112.	5.97	2.05	6,242	6,452	2,42E-4	-0,1074	1,1243	44,90	0	a
113.	6.02	2.07	6,348	6,563	2,45E-4	-0,1112	1,1243	44,90	0	a
114.	6.07	2.08	6,454	6,672	2,48E-4	-0,1138	1,1356	45,35	0	a
115.	6.14	2.10	6,590	6,813	2,51E-4	-0,1178	1,1441	45,69	0	a
116.	6.21	2.13	6,740	6,968	2,56E-4	-0,1231	1,1444	45,70	0	a
117.	6.26	2.15	6,847	7,079	2,59E-4	-0,1271	1,1427	45,63	0	a
118.	6.31	2.16	6,957	7,193	2,62E-4	-0,1298	1,1545	46,10	0	a
119.	6.37	2.19	7,102	7,343	2,66E-4	-0,1339	1,1650	46,52	0	a
120.	6.42	2.20	7,212	7,457	2,69E-4	-0,1381	1,1623	46,41	0	a
121.	6.47	2.22	7,324	7,573	2,72E-4	-0,1423	1,1603	46,33	0	a
122.	6.54	2.24	7,468	7,722	2,76E-4	-0,1451	1,1830	47,24	0	a
123.	6.60	2.26	7,595	7,853	2,80E-4	-0,1494	1,1850	47,32	0	a
124.	6.66	2.28	7,740	8,004	2,84E-4	-0,1552	1,1791	47,09	0	a
125.	6.71	2.30	7,866	8,134	2,87E-4	-0,1581	1,1947	47,71	0	a
126.	6.76	2.32	7,979	8,251	2,91E-4	-0,1625	1,1909	47,56	0	a
127.	6.81	2.34	8,096	8,372	2,94E-4	-0,1654	1,2035	48,06	0	a
128.	6.86	2.35	8,215	8,495	2,97E-4	-0,1699	1,2008	47,95	0	a
129.	6.91	2.37	8,341	8,625	3,01E-4	-0,1729	1,2153	48,53	0	a
130.	6.96	2.39	8,456	8,744	3,04E-4	-0,1775	1,2103	48,33	0	a
131.	7.01	2.40	8,577	8,870	3,07E-4	-0,1806	1,2224	48,81	0	a
132.	7.08	2.43	8,739	9,037	3,12E-4	-0,1867	1,2189	48,68	0	a
133.	7.13	2.44	8,861	9,164	3,15E-4	-0,1899	1,2303	49,13	0	a
134.	7.20	2.47	9,033	9,342	3,20E-4	-0,1962	1,2288	49,07	0	a
135.	7.26	2.49	9,192	9,506	3,25E-4	-0,2009	1,2381	49,44	0	a
136.	7.31	2.51	9,331	9,651	3,29E-4	-0,2057	1,2397	49,51	0	a
137.	7.37	2.53	9,476	9,800	3,33E-4	-0,2090	1,2577	50,22	0	a
138.	7.43	2.55	9,619	9,948	3,37E-4	-0,2139	1,2598	50,31	0	a
139.	7.50	2.57	9,820	10,156	3,42E-4	-0,2205	1,2651	50,52	0	a
140.	7.60	2.61	10,045	10,389	3,49E-4	-0,2272	1,2781	51,04	0	a
141.	7.67	2.63	10,260	10,612	3,55E-4	-0,2339	1,2875	51,41	0	a
142.	7.73	2.65	10,410	10,768	3,59E-4	-0,2390	1,2901	51,52	0	a
143.	7.81	2.68	10,623	10,988	3,65E-4	-0,2459	1,2968	51,78	0	a
144.	7.89	2.71	10,849	11,222	3,71E-4	-0,2529	1,3071	52,20	0	a
145.	7.97	2.73	11,070	11,451	3,78E-4	-0,2599	1,3157	52,54	0	a
146.	8.03	2.75	11,229	11,615	3,82E-4	-0,2652	1,3192	52,68	0	a
147.	8,09	2,78	11,401	11,793	3,87E-4	-0,2706	1,3263	52,96	0	a
148.	8,18	2,80	11,637	12,038	3,94E-4	-0,2797	1,3196	52,70	0	a
149.	8,25	2,83	11,836	12,243	3,99E-4	-0,2852	1,3350	53,31	0	a
150.	8,31	2,85	12,014	12,432	4,04E-4	-0,3353	0,9073	36,23	0	a
151.	8,37	2,87	12,203	12,629	4,10E-4	-0,3434	0,8942	35,71	0	a
152.	8,45	2,90	12,424	12,857	4,16E-4	-0,3512	0,8949	35,74	0	a
153.	8,51	2,92	12,597	13,036	4,21E-4	-0,3551	0,9171	36,62	0	a
154.	8,58	2,94	12,806	13,253	4,27E-4	-0,3631	0,9117	36,41	0	a
155.	8,64	2,96	12,996	13,449	4,32E-4	-0,3693	0,9172	36,63	0	a
156.	8,72	2,99	13,220	13,681	4,38E-4	-0,3780	0,9102	36,35	0	a
157.	8,78	3,01	13,395	13,862	4,43E-4	-0,3842	0,9105	36,36	0	a
158.	8,85	3,03	13,612	14,088	4,49E-4	-0,3922	0,9081	36,26	0	a
159.	8,91	3,06	13,805	14,287	4,55E-4	-0,3969	0,9293	37,11	0	a
160.	9,00	3,09	14,070	14,561	4,62E-4	-0,4075	0,9178	36,65	0	a
161.	9,06	3,11	14,274	14,772	4,68E-4	-0,4137	0,9283	37,07	0	a
162.	9,13	3,13	14,501	15,008	4,74E-4	-0,4224	0,9224	36,83	0	a
163.	9,21	3,16	14,756	15,272	4,82E-4	-0,4289	0,9478	37,85	0	a
164.	9,30	3,19	15,023	15,548	4,89E-4	-0,4396	0,9362	37,39	0	a
165.	9,36	3,21	15,233	15,766	4,95E-4	-0,4459	0,9478	37,85	0	a
166.	9,42	3,23	15,420	15,959	5,00E-4	-0,4525	0,9483	37,87	0	a
167.	9,48	3,25	15,609	16,155	5,06E-4	-0,4597	0,9437	37,69	0	a
168.	9,54	3,27	15,799	16,352	5,11E-4	-0,4663	0,9455	37,76	0	a
169.	9,60	3,29	16,002	16,562	5,17E-4	-0,4735	0,9459	37,77	0	a
170.	9,66	3,31	16,225	16,792	5,23E-4	-0,4801	0,9588	38,29	0	a
171.	9,72	3,33	16,415	16,990	5,28E-4	-0,4897	0,9313	37,19	0	a
172.	9,78	3,35	16,610	17,192	5,34E-4	-0,4945	0,9524	38,03	0	a
173.	9,84	3,37	16,806	17,395	5,39E-4	-0,5011	0,9562	38,18	0	a
174.	9,90	3,40	17,016	17,612	5,45E-4	-0,5079	0,9627	38,44	0	a
175.	9,96	3,42	17,241	17,845	5,51E-4	-0,5151	0,9707	38,77	0	a
176.	10,05	3,45	17,531	18,145	5,60E-4	-0,5270	0,9555	38,16	0	a
177.	10,12	3,47	17,770	18,392	5,66E-4	-0,5340	0,9703	38,75	0	a
178.	10,21	3,50	18,071	18,704	5,75E-4	-0,5440	0,9774	39,03	0	a
179.	10,27	3,52	18,305	18,946	5,81E-4	-0,5536	0,9650	38,54	0	a
180.	10,35	3,55	18,590	19,241	5,89E-4	-0,5635	0,9675	38,63	0	a
181.	10,42	3,57	18,831	19,491	5,96E-4	-0,5710	0,9781	39,06	0	a
182.	10,50	3,60	19,138	19,809	6,05E-4	-0,5811	0,9864	39,39	0	a
183.	10,57	3,62	19,376	20,055	6,12E-4	-0,5909	0,9735	38,87	0	a
184.	10,65	3,65	19,685	20,375	6,20E-4	-0,6013	0,9794	39,11	0	a
185.	10,72	3,68	19,930	20,629	6,27E-4	-0,6085	0,9944	39,71	0	a
186.	10,77	3,69	20,104	20,810	6,32E-4	-0,6166	0,9760	38,98	0	a

187.	16,24	0,00	20,225	20,938	0	-0,6582	0,6120	24,44	0	r
188.	16,28	0,0147	20,224	20,938	-0,00687	-0,6582	0,6187	24,71	0	r
189.	16,32	0,0292	20,223	20,936	-0,00686	-0,6582	0,6182	24,69	0	r
190.	16,37	0,0466	20,220	20,933	-0,00686	-0,6582	0,6173	24,65	0	r
191.	16,43	0,0648	20,217	20,930	-0,00686	-0,6582	0,6162	24,61	0	r
192.	16,47	0,0806	20,213	20,926	-0,00686	-0,6582	0,6147	24,55	0	r
193.	16,52	0,0981	20,208	20,921	-0,00686	-0,6582	0,6130	24,48	0	r
194.	16,58	0,116	20,202	20,915	-0,00686	-0,6582	0,6109	24,40	0	r
195.	16,63	0,133	20,195	20,908	-0,00686	-0,6582	0,6086	24,30	0	r
196.	16,68	0,150	20,187	20,900	-0,00685	-0,6582	0,6059	24,19	0	r
197.	16,73	0,167	20,179	20,891	-0,00685	-0,6582	0,6029	24,08	0	r
198.	16,77	0,182	20,171	20,883	-0,00685	-0,6582	0,6003	23,97	0	r
199.	16,81	0,197	20,163	20,874	-0,00684	-0,6582	0,5972	23,85	0	r
200.	16,86	0,215	20,152	20,863	-0,00684	-0,6582	0,5935	23,70	0	r
201.	16,91	0,231	20,140	20,851	-0,00684	-0,6581	0,5904	23,58	0	r
202.	16,97	0,249	20,128	20,838	-0,00683	-0,6581	0,5860	23,40	0	r
203.	17,01	0,265	20,114	20,824	-0,00683	-0,6580	0,5822	23,25	0	r
204.	17,07	0,284	20,100	20,809	-0,00682	-0,6580	0,5773	23,06	0	r
205.	17,11	0,300	20,085	20,794	-0,00682	-0,6579	0,5730	22,88	0	r
206.	17,17	0,318	20,069	20,777	-0,00681	-0,6578	0,5683	22,70	0	r
207.	17,21	0,334	20,052	20,760	-0,00681	-0,6577	0,5634	22,50	0	r
208.	17,27	0,353	20,034	20,741	-0,0068	-0,6576	0,5582	22,29	0	r
209.	17,31	0,369	20,015	20,722	-0,00679	-0,6573	0,5546	22,15	0	r
210.	17,37	0,387	19,996	20,702	-0,00679	-0,6571	0,5498	21,95	0	r
211.	17,41	0,403	19,975	20,680	-0,00678	-0,6569	0,5446	21,75	0	r
212.	17,47	0,422	19,954	20,658	-0,00677	-0,6565	0,5410	21,60	0	r
213.	17,51	0,438	19,932	20,636	-0,00677	-0,6563	0,5354	21,38	0	r
214.	17,57	0,456	19,909	20,612	-0,00676	-0,6560	0,5303	21,18	0	r
215.	17,62	0,473	19,885	20,587	-0,00675	-0,6555	0,5266	21,03	0	r
216.	17,67	0,490	19,860	20,562	-0,00674	-0,6550	0,5231	20,89	0	r
217.	17,72	0,507	19,834	20,535	-0,00673	-0,6547	0,5170	20,65	0	r
218.	17,77	0,525	19,809	20,508	-0,00673	-0,6541	0,5139	20,52	0	r
219.	17,82	0,541	19,781	20,480	-0,00672	-0,6537	0,5081	20,29	0	r
220.	17,87	0,559	19,753	20,451	-0,00671	-0,6530	0,5053	20,18	0	r
221.	17,92	0,576	19,724	20,420	-0,0067	-0,6526	0,4988	19,92	0	r
222.	17,97	0,594	19,693	20,389	-0,00669	-0,6519	0,4952	19,77	0	r
223.	18,02	0,610	19,663	20,358	-0,00668	-0,6511	0,4926	19,67	0	r
224.	18,07	0,628	19,632	20,325	-0,00667	-0,6506	0,4864	19,42	0	r
225.	18,12	0,644	19,599	20,292	-0,00665	-0,6498	0,4829	19,29	0	r
226.	18,17	0,663	19,566	20,257	-0,00664	-0,6493	0,4761	19,01	0	r
227.	18,22	0,679	19,532	20,222	-0,00663	-0,6484	0,4731	18,89	0	r
228.	18,27	0,697	19,497	20,186	-0,00662	-0,6478	0,4666	18,63	6,35	r
229.	18,32	0,713	19,461	20,149	-0,00661	-0,6469	0,4629	18,49	9,62	r
230.	18,37	0,731	19,425	20,112	-0,0066	-0,6462	0,4574	18,26	13,08	r
231.	18,42	0,748	19,386	20,071	-0,00658	-0,6452	0,4535	18,11	15,00	r
232.	18,47	0,767	19,348	20,032	-0,00657	-0,6445	0,4469	17,85	17,84	r
233.	18,52	0,783	19,307	19,990	-0,00656	-0,6433	0,4446	17,75	18,77	r
234.	18,57	0,801	19,267	19,948	-0,00654	-0,6425	0,4384	17,51	21,00	r
235.	18,62	0,817	19,227	19,907	-0,00653	-0,6413	0,4361	17,42	21,74	r
236.	18,67	0,835	19,185	19,863	-0,00651	-0,6405	0,4293	17,14	23,90	r
237.	18,72	0,851	19,142	19,818	-0,0065	-0,6392	0,4269	17,05	24,61	r
238.	18,77	0,870	19,098	19,773	-0,00649	-0,6383	0,4204	16,79	26,45	r
239.	18,84	0,892	19,045	19,718	-0,00647	-0,6369	0,4156	16,60	27,73	r
240.	18,89	0,909	18,994	19,665	-0,00645	-0,6356	0,4105	16,39	29,03	r
241.	18,94	0,926	18,947	19,617	-0,00643	-0,6342	0,4079	16,29	29,70	r
242.	18,99	0,943	18,898	19,566	-0,00642	-0,6332	0,4006	16,00	31,43	r
243.	19,04	0,961	18,850	19,517	-0,0064	-0,6318	0,3976	15,88	32,14	r
244.	19,08	0,974	18,812	19,478	-0,00639	-0,6308	0,3942	15,74	32,91	r
245.	19,12	0,989	18,770	19,434	-0,00637	-0,6298	0,3892	15,54	34,02	r
246.	19,18	1,01	18,717	19,379	-0,00636	-0,6288	0,3803	15,19	35,90	r
247.	19,22	1,02	18,668	19,329	-0,00634	-0,6272	0,3791	15,14	36,15	r
248.	19,27	1,04	18,616	19,274	-0,00632	-0,6261	0,3715	14,84	37,70	r
249.	19,32	1,06	18,559	19,216	-0,0063	-0,6244	0,3685	14,72	38,29	r
250.	19,37	1,08	18,508	19,163	-0,00629	-0,6232	0,3625	14,48	39,46	r
251.	19,42	1,09	18,453	19,106	-0,00627	-0,6214	0,3609	14,41	39,77	r
252.	19,48	1,11	18,384	19,034	-0,00624	-0,6196	0,3542	14,14	41,04	r
253.	19,56	1,14	18,311	18,959	-0,00622	-0,6177	0,3474	13,87	42,28	r
254.	19,59	1,15	18,257	18,903	-0,0062	-0,6158	0,3471	13,86	42,32	r
255.	19,64	1,17	18,207	18,851	-0,00618	-0,6145	0,3424	13,67	43,17	r
256.	19,69	1,18	18,143	18,785	-0,00616	-0,6126	0,3387	13,52	43,84	r
257.	19,74	1,20	18,083	18,723	-0,00614	-0,6112	0,3314	13,23	45,11	r
258.	19,79	1,22	18,025	18,663	-0,00612	-0,6099	0,3238	12,93	46,40	r
259.	19,84	1,24	17,959	18,595	-0,0061	-0,6079	0,3205	12,80	46,95	r
260.	19,89	1,25	17,896	18,529	-0,00608	-0,6058	0,3189	12,74	47,21	r
261.	19,95	1,27	17,821	18,452	-0,00605	-0,6044	0,3065	12,24	49,25	r
262.	20,01	1,29	17,751	18,379	-0,00603	-0,6022	0,3036	12,12	49,71	r
263.	20,08	1,32	17,666	18,292	-0,006	-0,6000	0,2957	11,81	50,97	r
264.	20,14	1,34	17,578	18,201	-0,00597	-0,5970	0,2942	11,75	51,20	r
265.	20,19	1,36	17,499	18,119	-0,00595	-0,5946	0,2902	11,59	51,83	r
266.	20,25	1,38	17,419	18,036	-0,00592	-0,5931	0,2769	11,06	53,87	r
267.	20,31	1,40	17,336	17,950	-0,00589	-0,5898	0,2802	11,19	53,37	r
268.	20,38	1,42	17,250	17,861	-0,00586	-0,5882	0,2657	10,61	55,53	r
269.	20,44	1,44	17,156	17,764	-0,00583	-0,5848	0,2662	10,63	55,46	r
270.	20,50	1,46	17,071	17,676	-0,0058	-0,5823	0,2611	10,43	56,22	r
271.	20,54	1,48	17,003	17,606	-0,00578	-0,5805	0,2550	10,18	57,11	r
272.	20,60	1,49	16,923	17,522	-0,00575	-0,5779	0,2523	10,08	57,49	r
273.	20,64	1,51	16,851	17,448	-0,00573	-0,5761	0,2449	9,78	58,56	r
274.	20,69	1,53	16,776	17,371	-0,0057	-0,5734	0,2453	9,79	58,51	r
275.	20,74	1,54	16,698	17,290	-0,00568	-0,5716	0,2356	9,41	59,89	r
276.	20,81	1,57	16,599	17,187	-0,00564	-0,5688	0,2284	9,12	60,89	r
277.	20,88	1,59	16,491	17,076	-0,00561	-0,5659	0,2192	8,75	62,18	r
278.	20,94	1,61	16,382	16,962	-0,00557	-0,5621	0,2181	8,71	62,32	r
279.	21,00	1,63	16,289	16,867	-0,00554	-0,5592	0,2142	8,56	62,85	r
280.	21,05	1,65	16,212	16,787	-0,00551	-0,5572	0,2068	8,26	63,86	r
281.	21,10	1,67	16,121	16,693	-0,00548	-0,5542	0,2046	8,17	64,17	r
282.	21,16	1,69	16,024	16,592	-0,00545	-0,5512	0,1998	7,98	64,81	r
283.	21,23	1,71	15,911	16,475	-0,00541	-0,5482	0,1897	7,58	66,16	r
284.	21,29	1,73	15,791	16,351	-0,00537	-0,5450	0,1794	7,16	67,54	r
285.	21,36	1,76	15,673	16,229	-0,00533	-0,5408	0,1794	7,16	67,54	r
286.	21,43	1,78	15,553	16,105	-0,00529	-0,5376	0,1688	6,74	68,93	r
287.	21,49	1,80	15,433	15,980	-0,00525	-0,5332	0,1697	6,78	68,81	r
288.	21,56	1,83	15,310	15,853	-0,00521	-0,5299	0,1591	6,35	70,19	r
289.	21,61	1,84	15,217	15,757	-0,00518	-0,5265	0,1600	6,39	70,08	r

290.	21,68	1,87	15,091	15,627	-0,00513	-0,5231	0,1494	5,97	71,45	r
291.	21,74	1,89	14,964	15,495	-0,00509	-0,5196	0,1393	5,56	72,74	r
292.	21,80	1,91	14,858	15,386	-0,00505	-0,5161	0,1365	5,45	73,09	r
293.	21,85	1,92	14,769	15,294	-0,00502	-0,5126	0,1397	5,58	72,69	r
294.	21,91	1,95	14,646	15,166	-0,00498	-0,5090	0,1320	5,27	73,67	r
295.	21,98	1,97	14,510	15,025	-0,00494	-0,5054	0,1198	4,78	75,22	r
296.	22,03	1,99	14,404	14,915	-0,0049	-0,5017	0,1188	4,74	75,34	r
297.	22,10	2,01	14,274	14,781	-0,00486	-0,4980	0,1098	4,38	76,48	r
298.	22,16	2,03	14,144	14,646	-0,00481	-0,4943	0,1005	4,01	77,64	r
299.	22,22	2,05	14,026	14,524	-0,00477	-0,4905	0,0965	3,85	78,14	r
300.	22,26	2,07	13,933	14,427	-0,00474	-0,4866	0,1021	4,08	77,44	r
301.	22,31	2,08	13,830	14,321	-0,00471	-0,4840	0,0916	3,66	78,75	r
302.	22,37	2,10	13,723	14,210	-0,00467	-0,4801	0,0925	3,70	78,63	r
303.	22,43	2,12	13,587	14,069	-0,00462	-0,4761	0,0841	3,36	79,69	r
304.	22,50	2,15	13,439	13,916	-0,00457	-0,4721	0,0716	2,86	81,23	r
305.	22,56	2,17	13,302	13,775	-0,00453	-0,4680	0,0640	2,56	82,17	r
306.	22,63	2,19	13,148	13,615	-0,00448	-0,4625	0,0640	2,56	82,16	r
307.	22,70	2,22	12,997	13,459	-0,00443	-0,4584	0,0516	2,06	83,70	r
308.	22,77	2,24	12,858	13,315	-0,00438	-0,4542	0,0442	1,76	84,60	r
309.	22,83	2,26	12,690	13,141	-0,00432	-0,4486	0,0401	1,60	85,10	r
310.	22,90	2,29	12,537	12,983	-0,00427	-0,4428	0,0435	1,74	84,68	r
311.	22,97	2,31	12,390	12,831	-0,00422	-0,4385	0,0344	1,38	85,79	r
312.	23,03	2,33	12,239	12,674	-0,00417	-0,4341	0,0247	0,99	86,98	r
313.	23,09	2,35	12,110	12,541	-0,00413	-0,4297	0,0228	0,91	87,21	r
314.	23,17	2,38	11,935	12,360	-0,00407	-0,4251	0,0068	0,27	89,17	r
315.	23,22	2,39	11,797	12,217	-0,00402	-0,4206	0,0025	0,10	89,70	r
316.	23,29	2,42	11,649	12,063	-0,00397	-0,4160	-0,0043	-0,17	90,52	r
317.	23,35	2,44	11,468	11,877	-0,00391	-0,4098	-0,0065	-0,26	90,79	r
318.	23,40	2,46	11,346	11,749	-0,00387	-0,4051	-0,0034	-0,14	90,41	r
319.	23,45	2,47	11,221	11,621	-0,00383	-0,4020	-0,0164	-0,66	92,01	r
320.	23,50	2,49	11,094	11,489	-0,00378	-0,3972	-0,0140	-0,56	91,71	r
321.	23,55	2,51	10,970	11,360	-0,00374	-0,3940	-0,0259	-1,03	93,16	r
322.	23,60	2,53	10,843	11,229	-0,0037	-0,3892	-0,0232	-0,93	92,83	r
323.	23,65	2,54	10,716	11,097	-0,00366	-0,3860	-0,0364	-1,45	94,44	r
324.	23,70	2,56	10,586	10,964	-0,00361	-0,3811	-0,0335	-1,34	94,09	r
325.	23,75	2,58	10,457	10,830	-0,00357	-0,3779	-0,0473	-1,89	95,78	r
326.	23,80	2,60	10,327	10,694	-0,00352	-0,3729	-0,0440	-1,76	95,37	r
327.	23,86	2,61	10,195	10,559	-0,00348	-0,3696	-0,0575	-2,30	97,04	r
328.	23,90	2,63	10,063	10,422	-0,00344	-0,3646	-0,0548	-2,19	96,70	r
329.	23,96	2,65	9,930	10,284	-0,00339	-0,3612	-0,0678	-2,71	98,31	r
330.	24,01	2,66	9,796	10,145	-0,00335	-0,3560	-0,0637	-2,55	97,80	r
331.	24,07	2,69	9,618	9,961	-0,00328	-0,3509	-0,0760	-3,03	99,31	r
332.	24,14	2,71	9,439	9,775	-0,00322	-0,3439	-0,0702	-2,80	98,59	r
333.	24,21	2,73	9,251	9,581	-0,00316	-0,3386	-0,0839	-3,35	100,29	r
334.	24,26	2,75	9,114	9,440	-0,00311	-0,3351	-0,0972	-3,88	101,95	r
335.	24,31	2,77	8,975	9,295	-0,00307	-0,3297	-0,0930	-3,71	101,42	r
336.	24,37	2,79	8,790	9,104	-0,00301	-0,3243	-0,1048	-4,18	102,89	r
337.	24,42	2,81	8,651	8,960	-0,00296	-0,3189	-0,1004	-4,01	102,35	r
338.	24,47	2,82	8,509	8,811	-0,00291	-0,2977	0,0571	2,28	83,01	r
339.	24,54	2,85	8,327	8,620	-0,00285	-0,2636	0,3271	13,06	45,84	r
340.	24,60	2,87	8,168	8,455	-0,00279	-0,2597	0,3097	12,37	48,73	r
341.	24,66	2,89	7,983	8,264	-0,00273	-0,2538	0,3031	12,10	49,79	r
342.	24,71	2,91	7,832	8,107	-0,00268	-0,2477	0,3099	12,38	48,70	r
343.	24,76	2,92	7,685	7,955	-0,00263	-0,2413	0,3213	12,83	46,83	r
344.	24,81	2,94	7,535	7,800	-0,00258	-0,2373	0,3082	12,31	48,98	r
345.	24,86	2,96	7,389	7,648	-0,00253	-0,2315	0,3136	12,52	48,09	r
346.	24,91	2,97	7,239	7,494	-0,00248	-0,2275	0,3007	12,01	50,18	r
347.	24,96	2,99	7,089	7,338	-0,00243	-0,2218	0,3040	12,14	49,65	r
348.	25,01	3,01	6,938	7,181	-0,00238	-0,2167	0,3011	12,02	50,12	r
349.	25,09	3,04	6,700	6,935	-0,0023	-0,2086	0,2973	11,87	50,71	r
350.	25,17	3,06	6,446	6,672	-0,00221	-0,2005	0,2879	11,50	52,18	r
351.	25,23	3,08	6,277	6,497	-0,00216	-0,1941	0,2914	11,64	51,63	r
352.	25,28	3,10	6,113	6,327	-0,0021	-0,1878	0,2959	11,82	50,93	r
353.	25,35	3,13	5,879	6,086	-0,00202	-0,1814	0,2770	11,06	53,85	r
354.	25,44	3,16	5,612	5,809	-0,00193	-0,1704	0,2915	11,64	51,62	r
355.	25,51	3,18	5,372	5,560	-0,00185	-0,1619	0,2908	11,61	51,73	r
356.	25,59	3,21	5,130	5,310	-0,00177	-0,1551	0,2730	10,90	54,45	r
357.	25,65	3,23	4,920	5,092	-0,0017	-0,1479	0,2700	10,78	54,90	r
358.	25,73	3,26	4,672	4,835	-0,00161	-0,1373	0,2870	11,46	52,32	r
359.	25,79	3,28	4,479	4,635	-0,00155	-0,1330	0,2617	10,45	56,13	r
360.	25,86	3,30	4,249	4,397	-0,00147	-0,1237	0,2725	10,88	54,53	r
361.	25,93	3,32	4,027	4,167	-0,0014	-0,1167	0,2634	10,52	55,87	r
362.	26,01	3,35	3,758	3,889	-0,0013	-0,1073	0,2615	10,44	56,16	r
363.	26,07	3,37	3,536	3,659	-0,00123	-0,1007	0,2487	9,93	58,01	r
364.	26,13	3,39	3,340	3,456	-0,00116	-0,0912	0,2731	10,91	54,43	r
365.	26,19	3,41	3,122	3,230	-0,00109	-0,0861	0,2469	9,86	58,27	r
366.	26,27	3,44	2,844	2,942	-0,00104	-0,0746	0,2625	10,48	56,01	r
367.	26,33	3,46	2,649	2,740	-9,30E-4	-0,0676	0,2629	10,50	55,95	r
368.	26,39	3,48	2,435	2,519	-8,57E-4	-0,0623	0,2401	9,59	59,25	r
369.	26,47	3,51	2,147	2,221	-7,60E-4	-0,0504	0,2560	10,22	56,96	r
370.	26,55	3,54	1,896	1,961	-6,75E-4	-0,0432	0,2389	9,54	59,42	r
371.	26,61	3,56	1,669	1,726	-5,99E-4	-0,0362	0,2283	9,12	60,91	r
372.	26,70	3,59	1,350	1,396	-4,91E-4	-0,0235	0,2412	9,63	59,09	r
373.	26,76	3,61	1,118	1,155	-4,13E-4	-0,0158	0,2354	9,40	59,91	r
374.	26,83	3,63	0,872	0,901	-3,30E-4	-0,0059	0,2465	9,84	58,34	r
375.	26,91	3,66	0,578	0,596	-2,30E-4	0,0016	0,2171	8,67	62,46	r
376.	26,98	3,68	0,325	0,334	-1,45E-4	0,0120	0,2305	9,20	60,60	r
377.	27,06	3,71	0,028	0,027	-4,46E-5	0,0224	0,2287	9,13	60,85	r
378.	27,13	3,74	-0,235	-0,246	4,44E-5	0,0324	0,2346	9,37	60,03	cb
379.	27,21	3,76	-0,541	-0,562	1,47E-4	0,0425	0,2266	9,05	61,14	cb
380.	27,28	3,79	-0,797	-0,828	2,34E-4	0,0508	0,2181	8,71	62,32	cb
381.	27,36	3,81	-1,112	-1,154	3,40E-4	0,0612	0,2099	8,38	63,45	cb
382.	27,43	3,84	-1,369	-1,420	4,27E-4	0,0691	0,1974	7,88	65,15	cb
383.	27,51	3,87	-1,695	-1,757	5,37E-4	0,0825	0,2145	8,57	62,81	cb
384.	27,60	3,90	-2,024	-2,098	6,48E-4	0,0929	0,2013	8,04	64,61	cb
385.	27,66	3,92	-2,279	-2,362	7,34E-4	0,1007	0,1884	7,52	66,34	cb
386.	27,74	3,94	-2,540	-2,632	8,23E-4	0,1100	0,1880	7,51	66,39	cb
387.	27,81	3,97	-2,879	-2,983	9,37E-4	0,1154	0,1224	4,89	74,89	cb
388.	27,90	4,00	-3,216	-3,330	0,00105	0,1092	-0,0558	-	96,83	cb

.....
Temperaturangaben beziehen sich auf die Skala der ITS-90. **Standardabweichungen:** Verschiedentlich werden Regressionsfunktionen mit Standardabweichungen bzw. Varianzen qualifiziert.

Programm

Data created during execution of the IMPro "ContactAngle_atConstantLevel", type 4/4. Automatic self-repetition of the IMPro - the 15. Repetition. IMPro finished as projected.

Prüfmittel

Die Kraftmesseinrichtung (WZA224) wurde 5,5 Stunden vor dieser Messung von Augsburg-Lab justiert.

IMETER ID23903733: Technische Daten: Auflösung des Wägesystems 0,1 mg, Messunsicherheit (Linearität) 0,2 mg, Dichte der Justiermasse ρ_{cal} 8,00 g/cm³, Luftdichte ρ_{air} 1,11447 kg/m³; Schwerebeschleunigung g 9,80769 m/s². Pt100-Temperaturmessung: Auflösung 0,001 K, Messunsicherheit $\pm 0,01$ K, R° 100.0056 Ω , Kalibrierintervall 30 min (BN^o1, -41/200°C, 3S, FS15,8, Korrekturfunktion: $-0,0054 + 0,997591 \cdot \vartheta + 2,20165E-05 \cdot \vartheta^2 - 4,78431E-08 \cdot \vartheta^3$). Akquisitions-Softwareversion IMETER 7.4.20, LizenzN^o *3037-4759*, Windows 6.2,9200- Betriebssystem auf PC Ser.N^o6995684 (C, SSD).
