EFFECT OF SURFACE TREATMENT ON STATIC CONTACT ANGLE

FOR THE

ADVANCED ANIMAL HABITAT - CENTRIFUGE (AAH-C) PROJECT

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EXECUTIVE SUMMARY

Contact angles at the fluid solid interface were measured on various samples, which were treated by stone polishing (with 1200 grit), glass bead blasting (with 60-100 grit) and sand blasting (with medium grit sand) to create various surface energies.

Table 1: Summary of contact angles of urine or water on various substrates.

Fluid	Male Rat Urine				Water			
Treatment	Untreated	Sand-Blasted	Glass-Blasted	Polished	Untreated	Sand-Blasted	Glass-Blasted	Polished
Aluminum	67.0	18.8	43.0	54.0	56.5	76.0	62.0	69.5
Titanium	47.7	21.3	23.5	25.0	55.0	60.0	29.6	53.0
Ultem 1000®	74.0	54.0	50.5	42	74.5	30.5	28.0	44.0

1. INTRODUCTION

The purpose of this experiment was to determine how surface treatments of various materials affect the static contact angles of rat urine on these surfaces. The contact angles will be used to determine appropriate materials to be used as wicking channels for transporting liquid urine to collecting media.

1.1. CONTACT ANGLE

1.1.2. *Materials and Methods*

Sample coupons of treated and untreated aluminum, titanium, and Ultem 1000® were degreased with isopropanol and ultrasonicated four times in ultra-pure water for 10 minutes. Treatments of these samples included glass-blasting (GB), sand-blasting(SB), and polishing (P). Unfinished Aluminum and titanium were labeled U, and machined/unfinished Ultem 1000® was denoted M. A 5μL droplet of liquid was placed onto the surface using a 10μL Hamilton syringe (#170RNTLC). To measure the contact angle of rat urine and D.D.I.U.F (Degassed/Deionized/Ultrafiltered) water, pictures of the droplets were taken using an Optem Zoom 70XL (#29-96-91) lens and threaded TV tube (#29-90-72) attached to a Sony XC-75 CCD video camera module. The photographs were digitized using WinTV soft and hardware. A plot of the outline of each droplet was produced by the following methods. The contact angle was determined by measuring the angle between the horizontal and tangent to the outermost edge of the droplet.

1.1.2.1. *Determination of Droplet Profile*

Digitized images were processed using Matlab® to produce outlines of the droplets. The coordinates produced by Matlab® were imported into Microsoft Excel® and the contact angles were determined by linear regression of the first 50 data points.

1.1.3. ***Results***

The following figures include the original photographs of the droplets as well as their simulated profile. Figures 1-10 are the results taken with rat urine, and figures 11-20 are taken with the ultra-pure water.

Table 2: Viscosity of male rat urine (batch #71001) at 25.0°C.

Reverse-Flow Type					
Efflux time (s)		Kinematic Viscosity (cSt)		Dynamic Viscosity	
C	D	C	D	C	D
71.84	95.27	1.045272	1.0346322	1.04945309	1.03877073
71.12	94.65	1.034796	1.027899	1.03893518	1.0320106
70.88	94.69	1.031304	1.0283334	1.03542922	1.03244673
Standard Deviation		0.006390211		0.006415772	
Average		1.0337061		1.037840924	

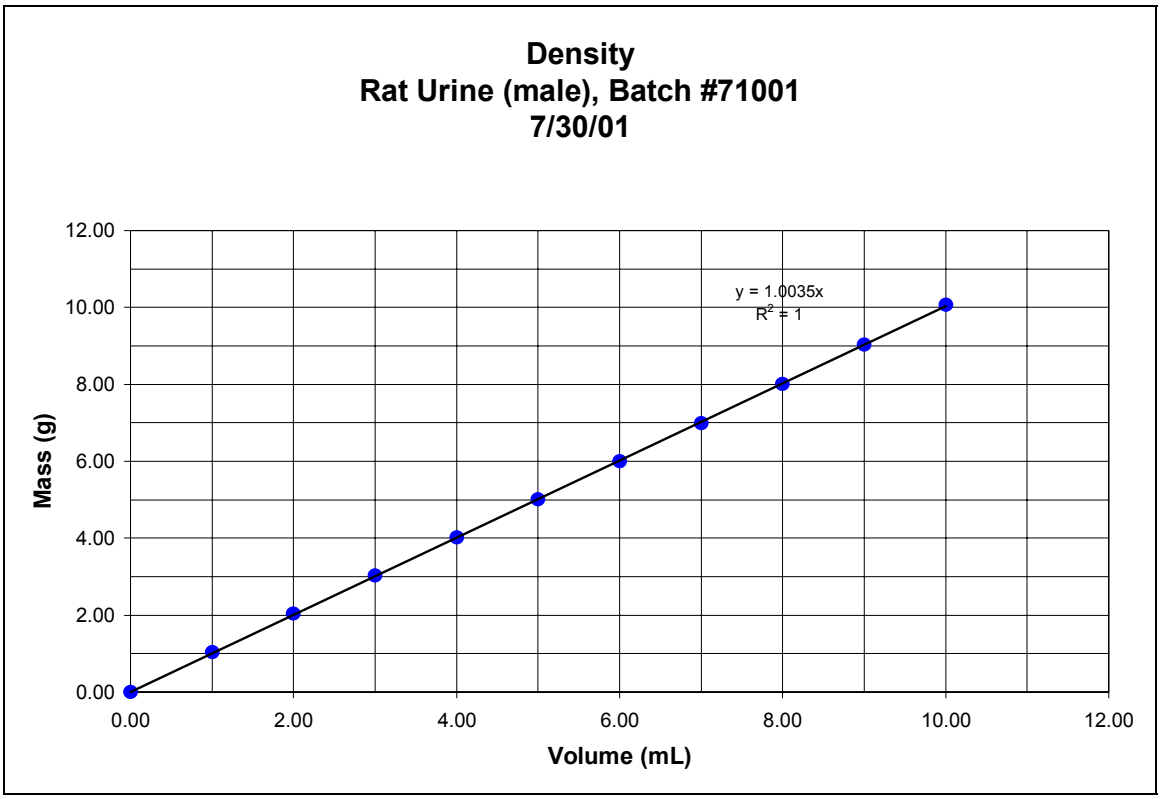


Figure 1: Density of male rat urine (batch #71001) at 25.0°C

Table 3: Surface tension of male rat urine (batch #71001) at 25.0°C.

Surface Tension mN/m
46.83
46.29
46.94
Average = 46.69±0.25

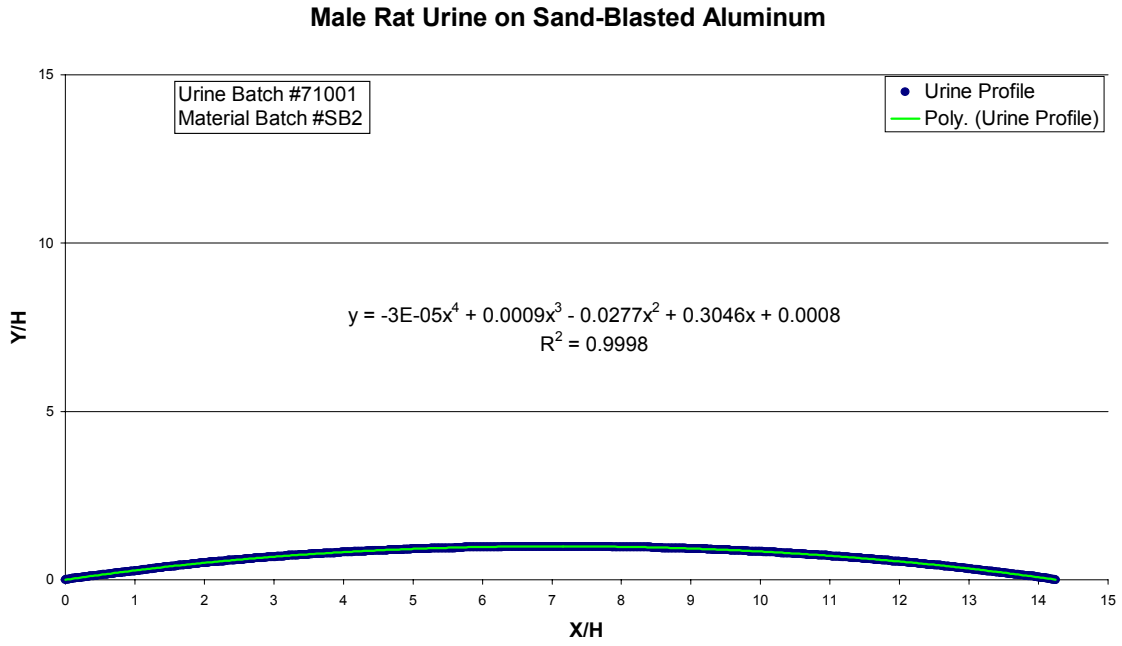
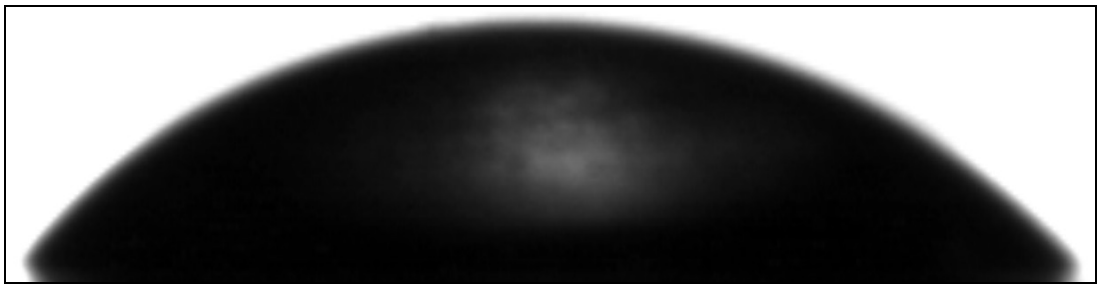


Figure 2: Male rat urine on sand-blasted Aluminum. Contact Angle, $\theta \approx 18.8°$



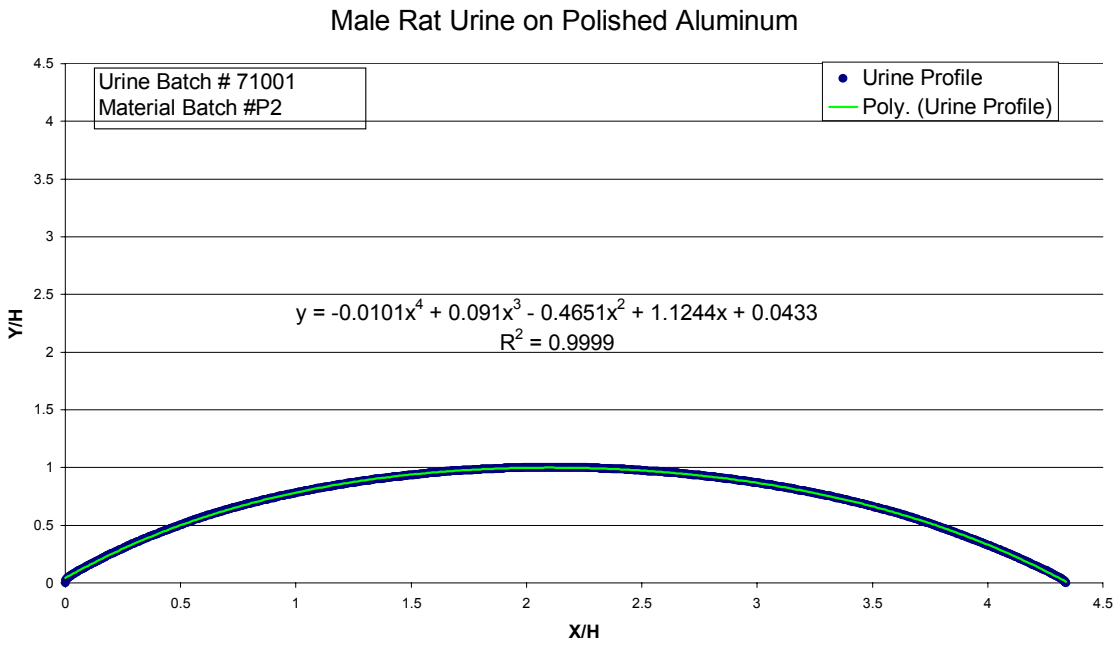
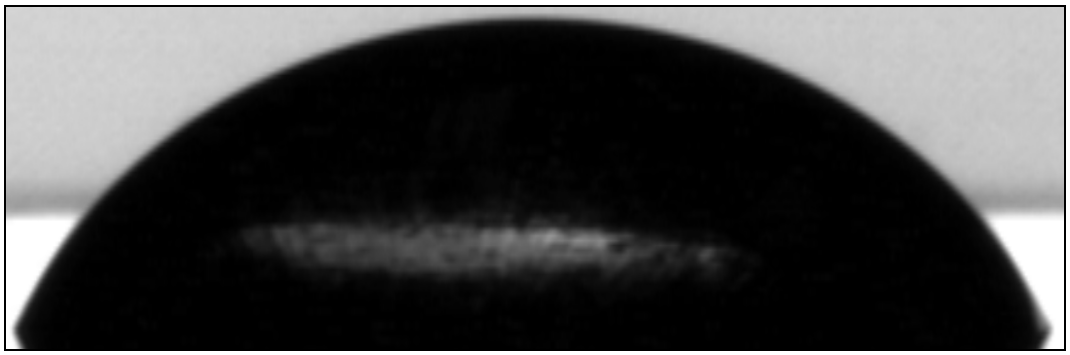


Figure 3: Male rat urine on polished aluminum substrate. Contact Angle, $\theta \approx 54.0°$



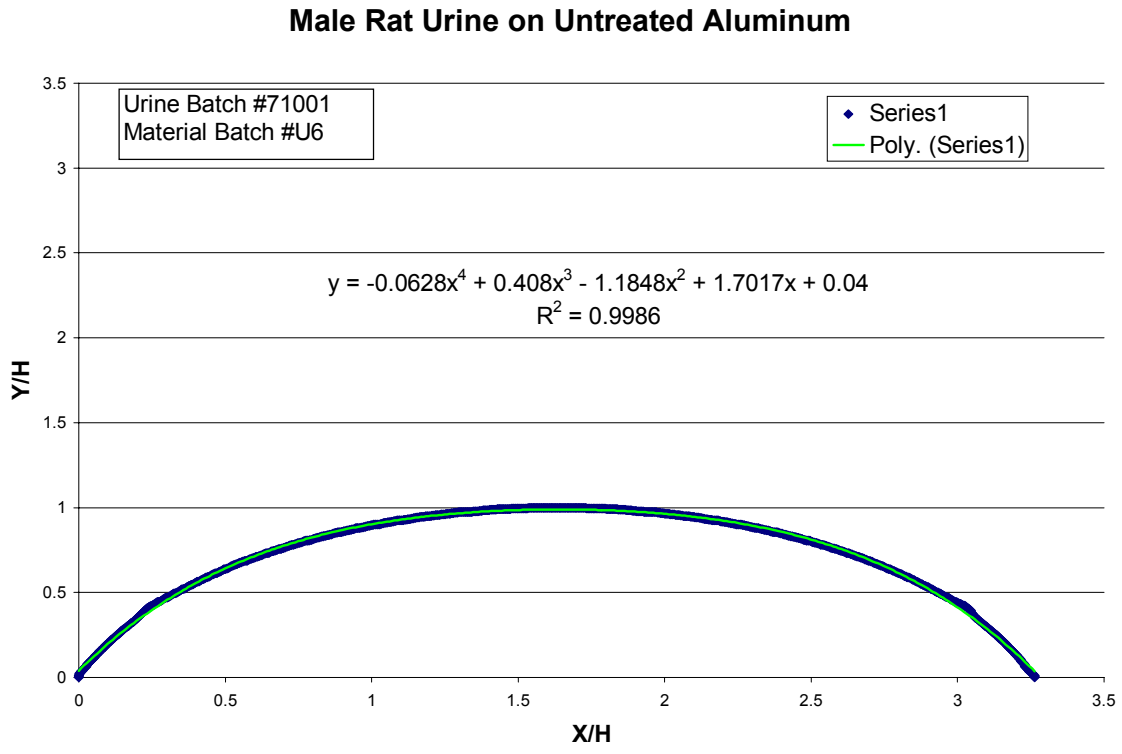
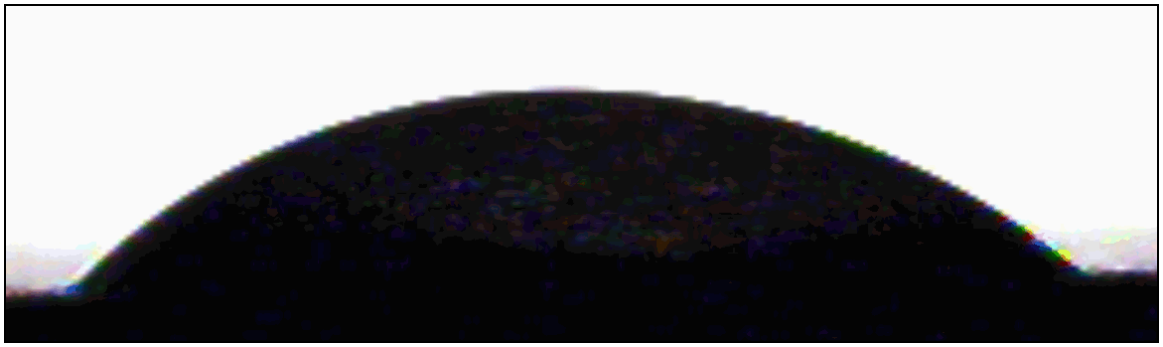


Figure 4: Male rat urine on untreated aluminum. Contact Angle, $\theta \approx 67.0°$



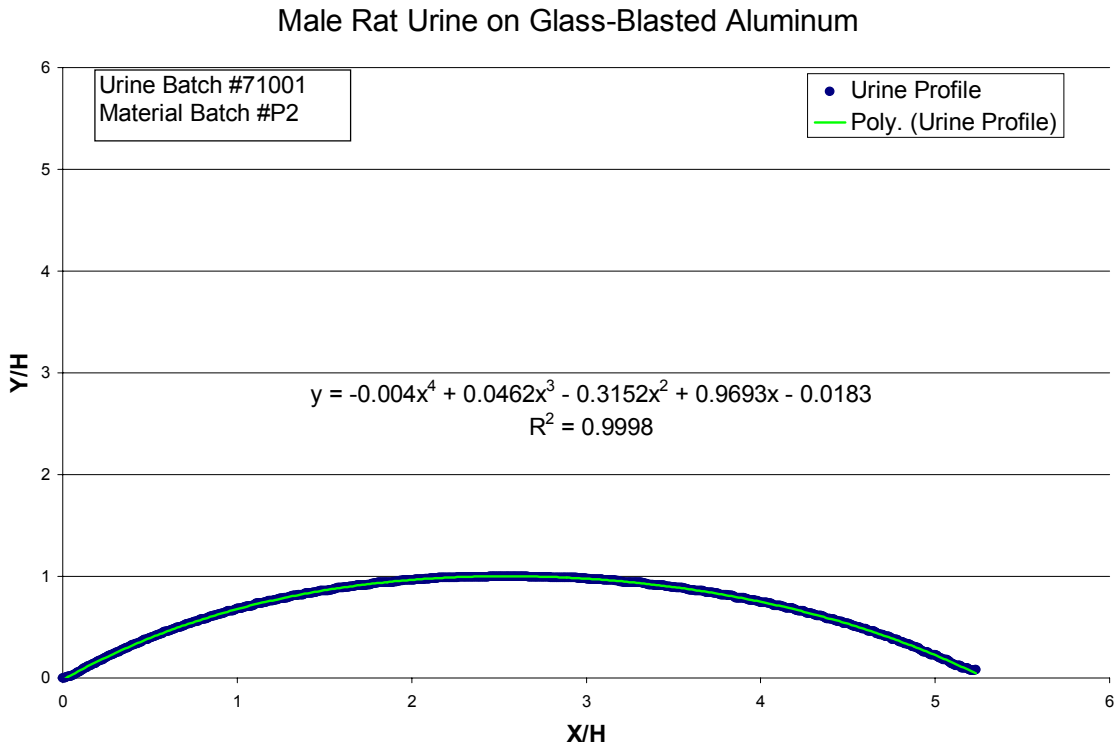


Figure 5:Male rat urine on glass-blasted aluminum. Contact Angle, $\theta \approx 43.0°$

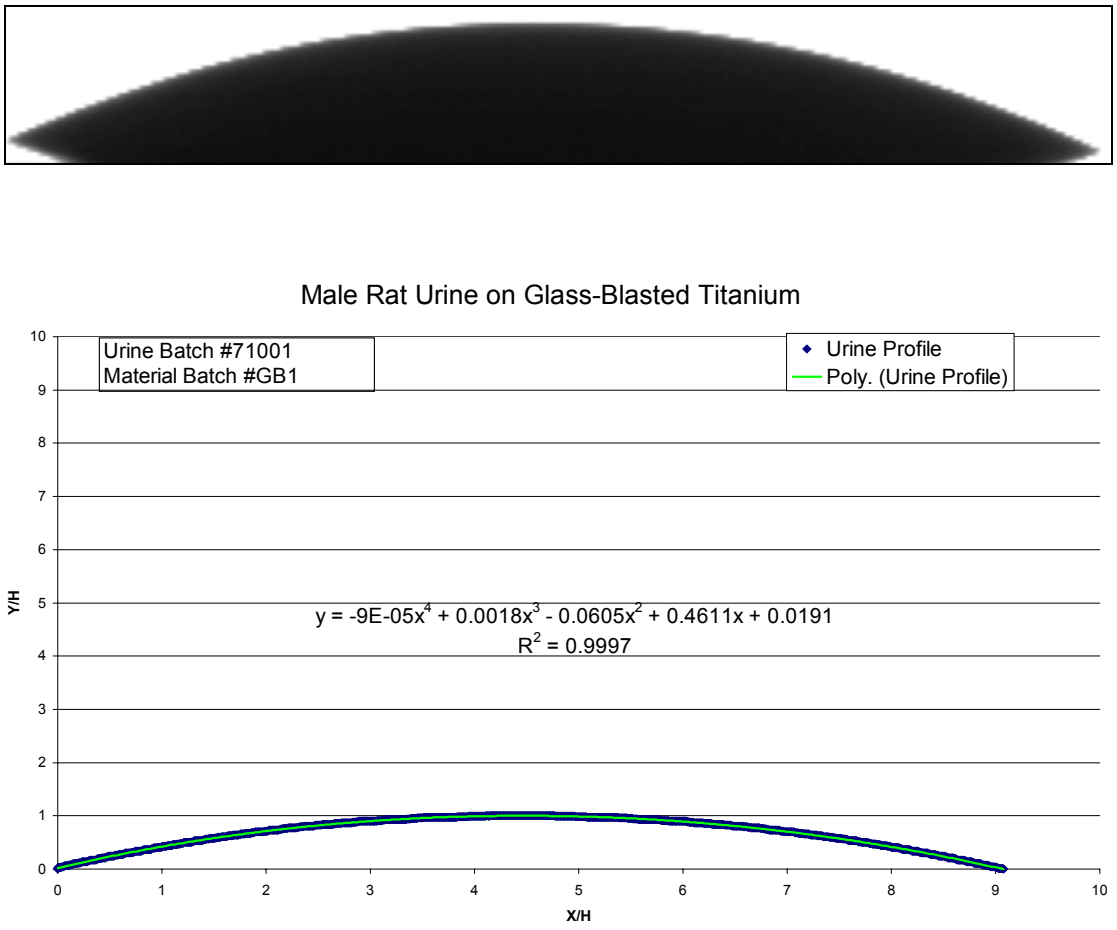
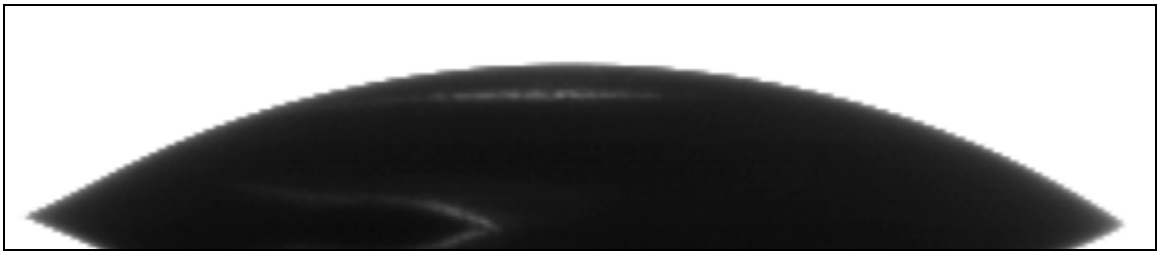


Figure 6: Rat urine on Glass Blasted Titanium. Contact Angle, $\theta \approx 23.5°$



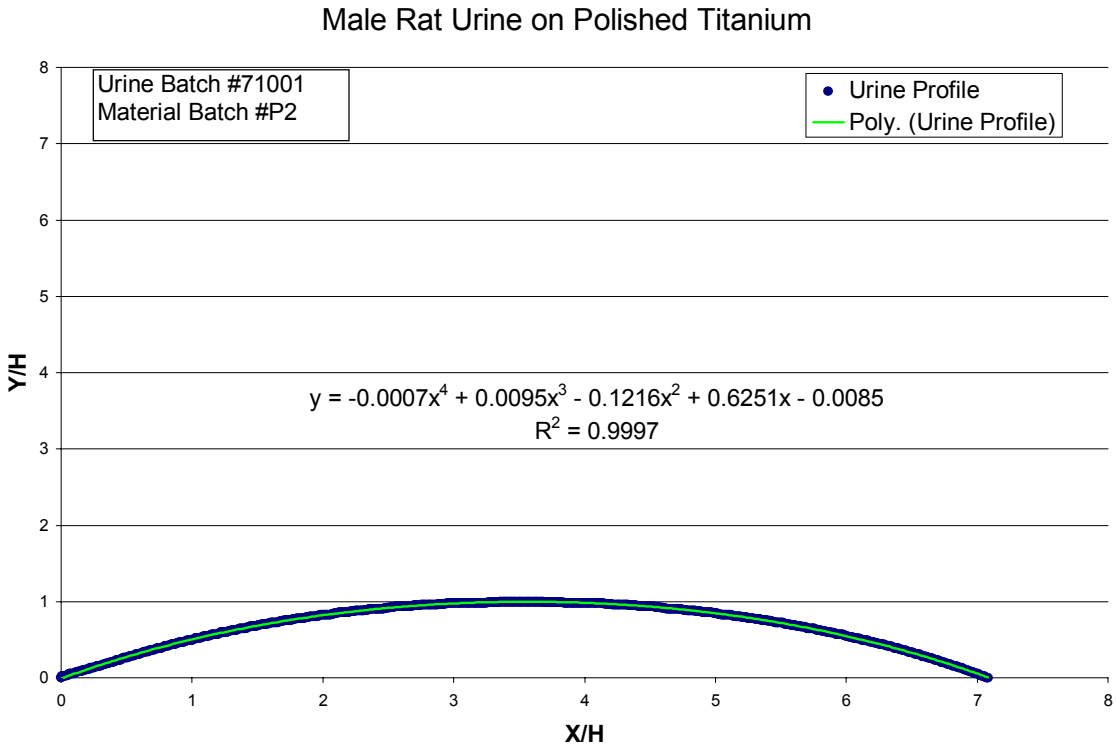
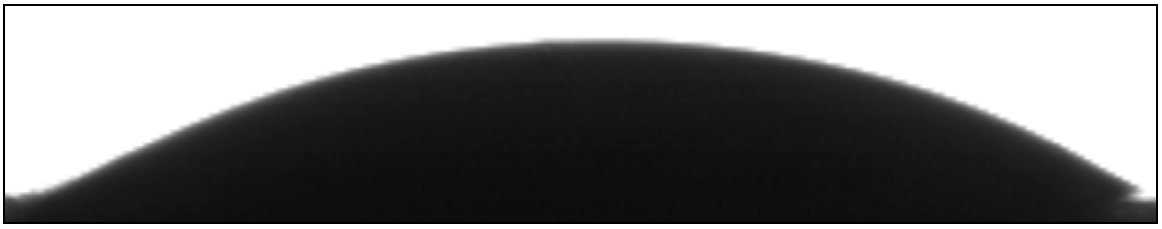


Figure 7: Male rat urine on Polished Titanium. Contact Angle, $\theta \approx 25.0°$



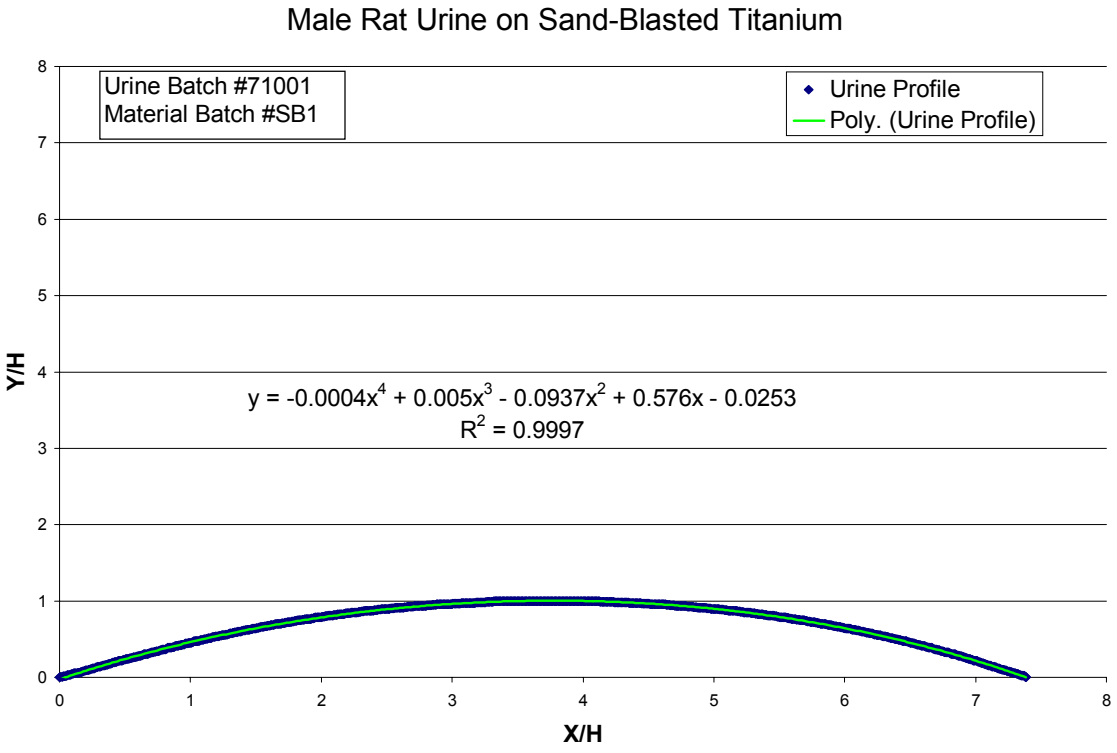


Figure 8: Male rat urine on Sand-Blasted Titanium. Contact Angle, $\theta \approx 21.3°$

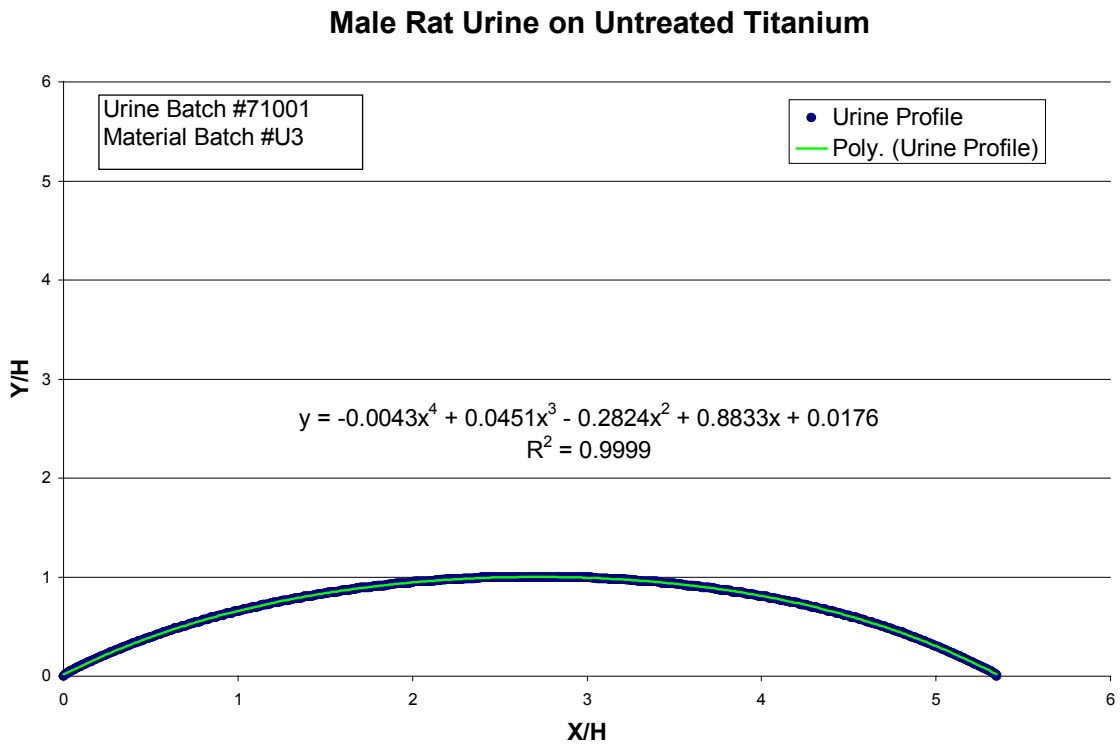
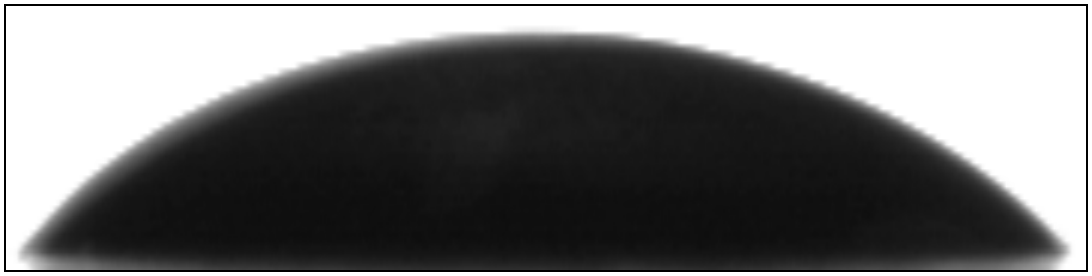


Figure 9: Male rat on Untreated Titanium. Contact Angle, $\theta \approx 47.7°$



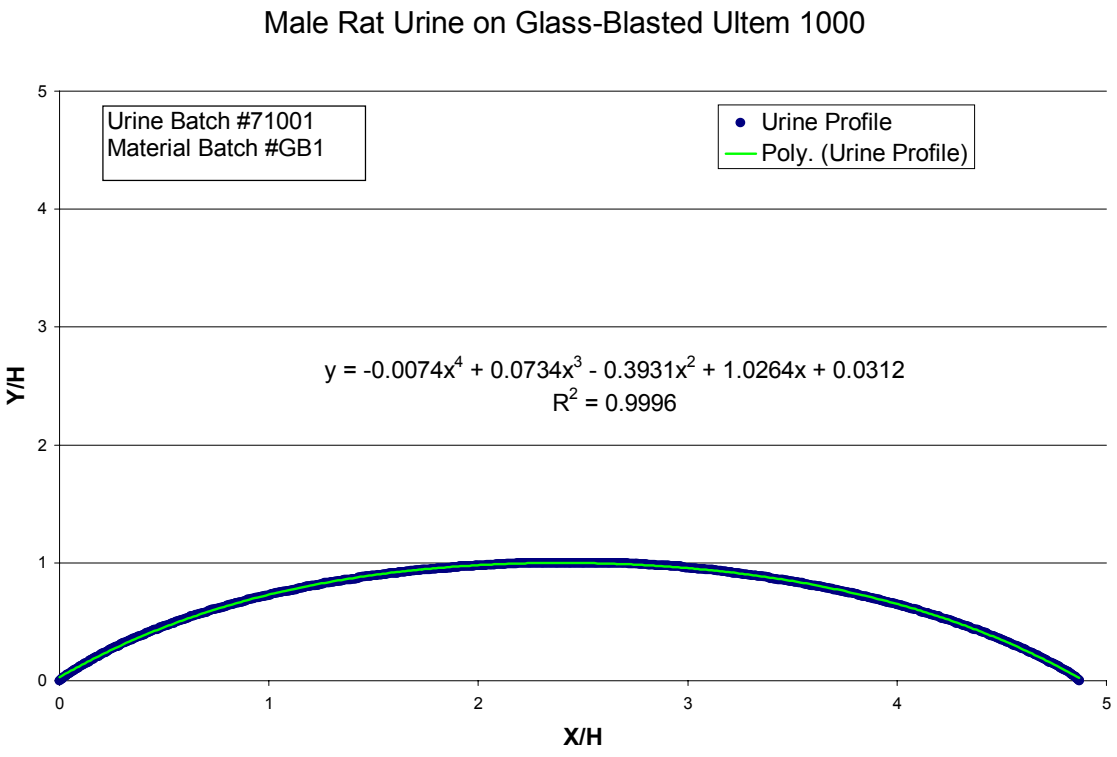


Figure 10: Male rat urine on Glass Blasted Ultem 1000®. Contact Angle, $\theta \approx 50.5°$

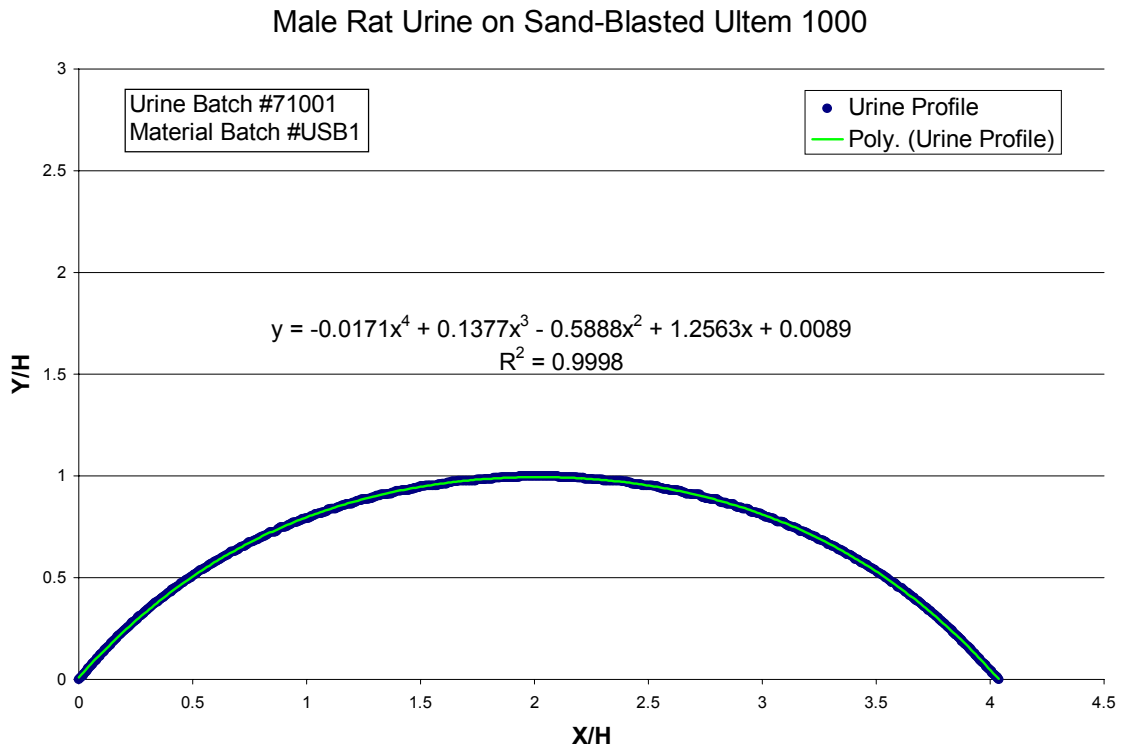
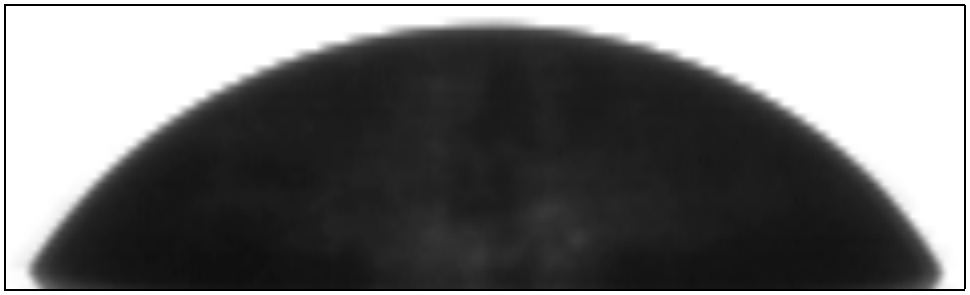


Figure 11: Male rat urine on sand-blasted Ultem 1000. Contact Angle, $\theta \approx 54.0°$



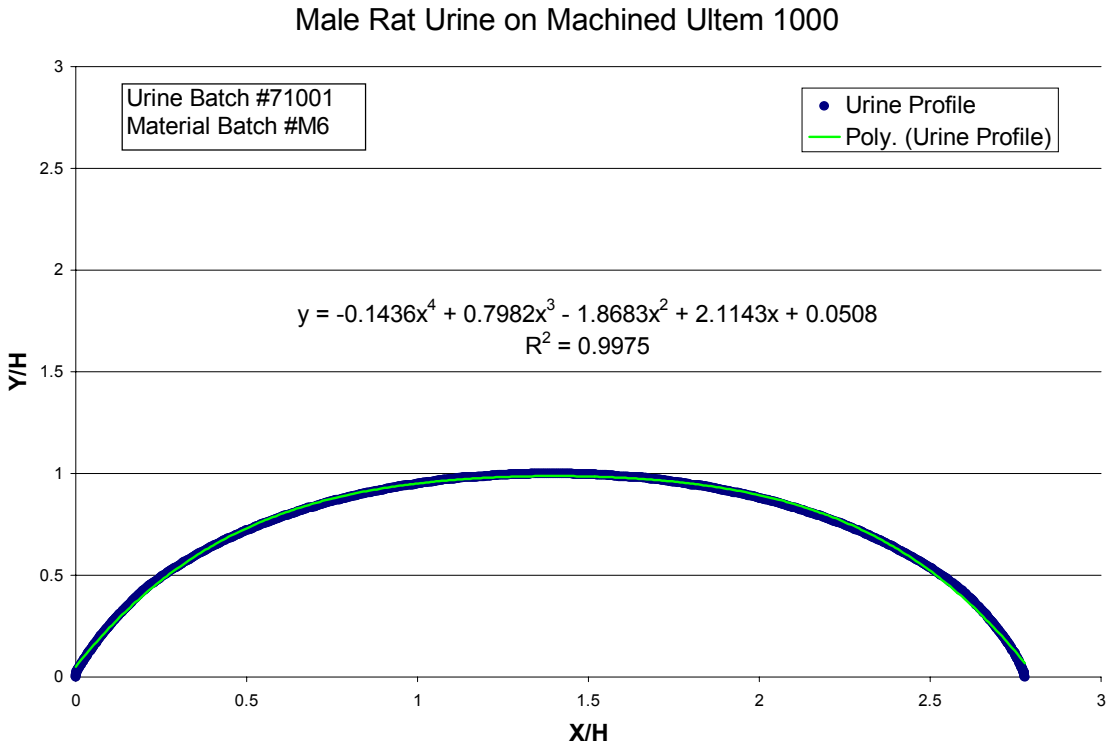
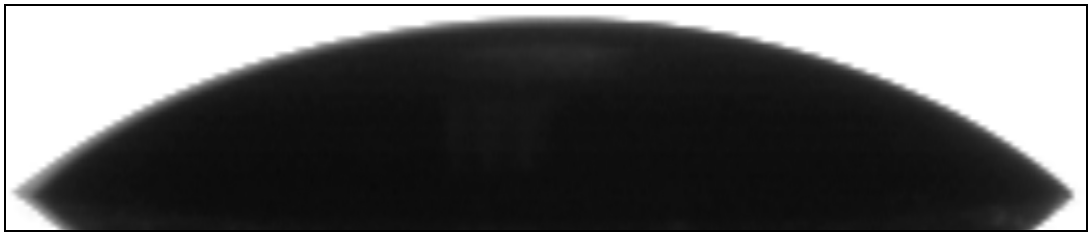


Figure 12: Male rat urine on machined Ultem 1000®. Contact Angle, θ ≈ 74.0°



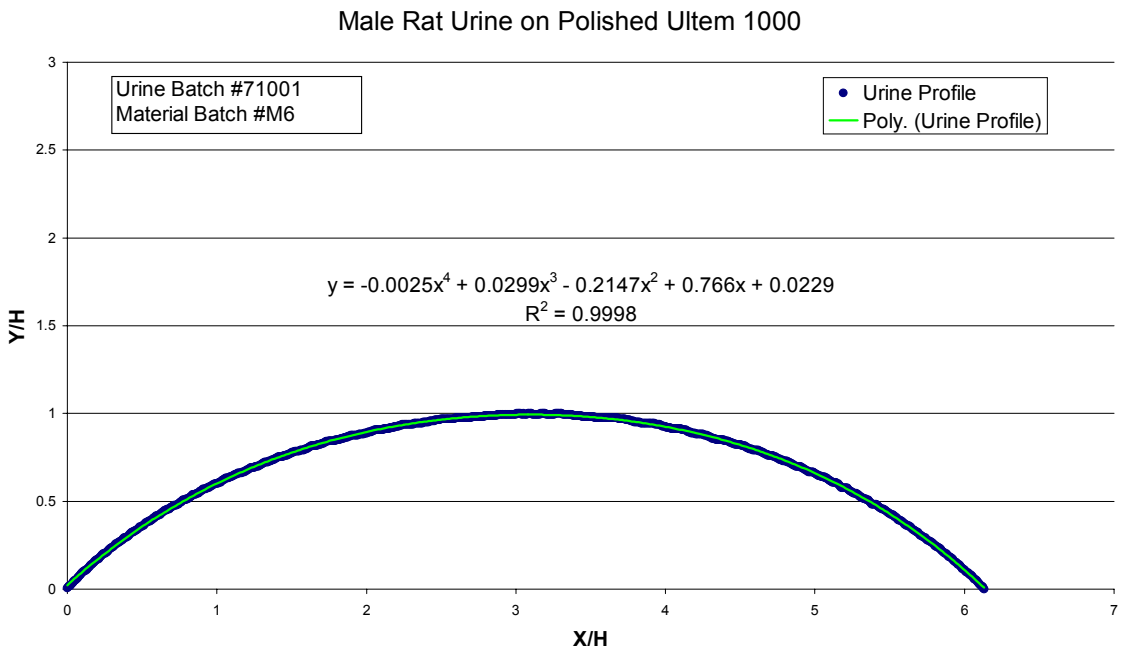
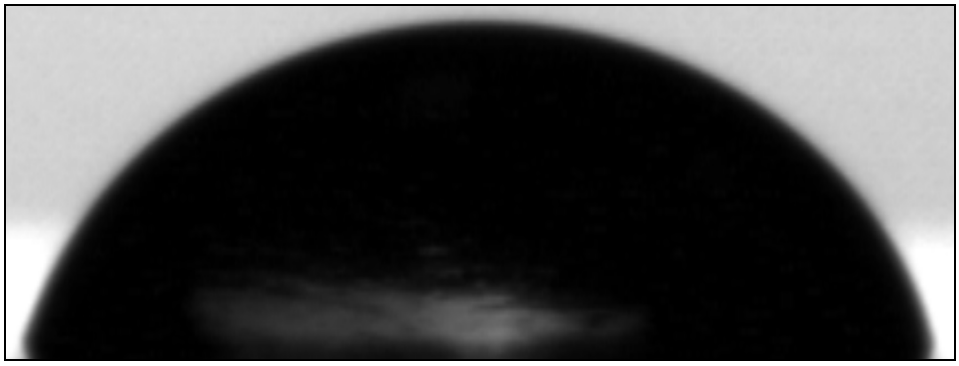


Figure 13: Male rat urine on polished Ultem 1000®. Contact Angle, θ ≈ 42.0°



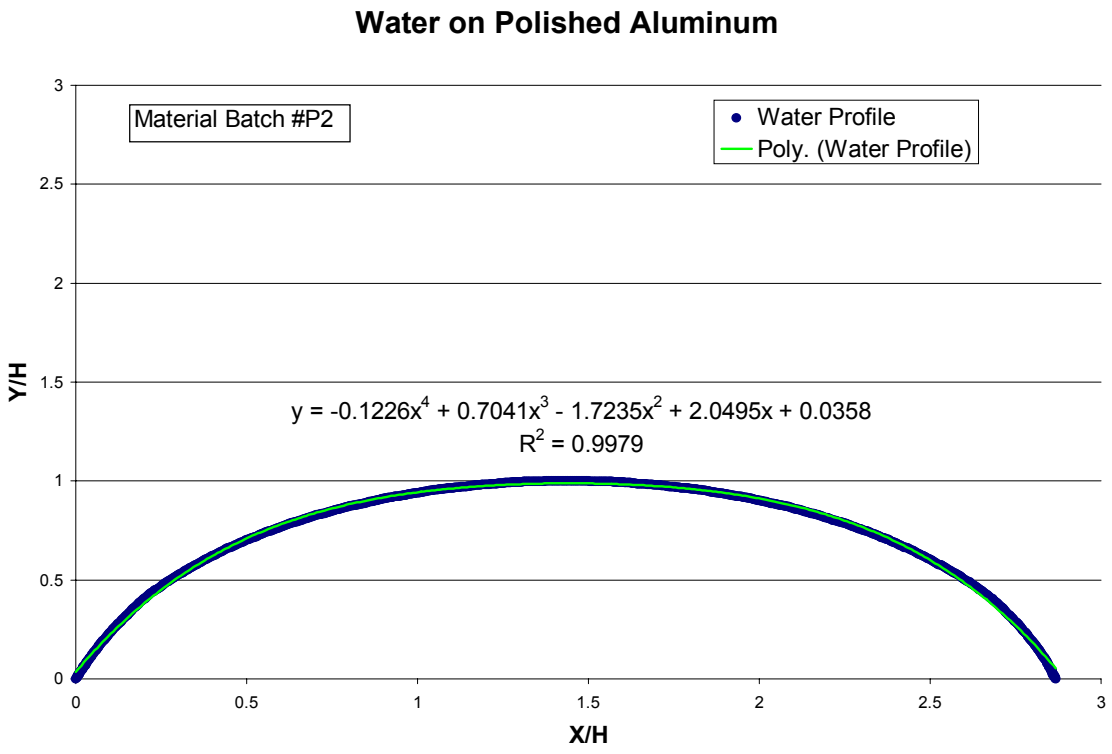
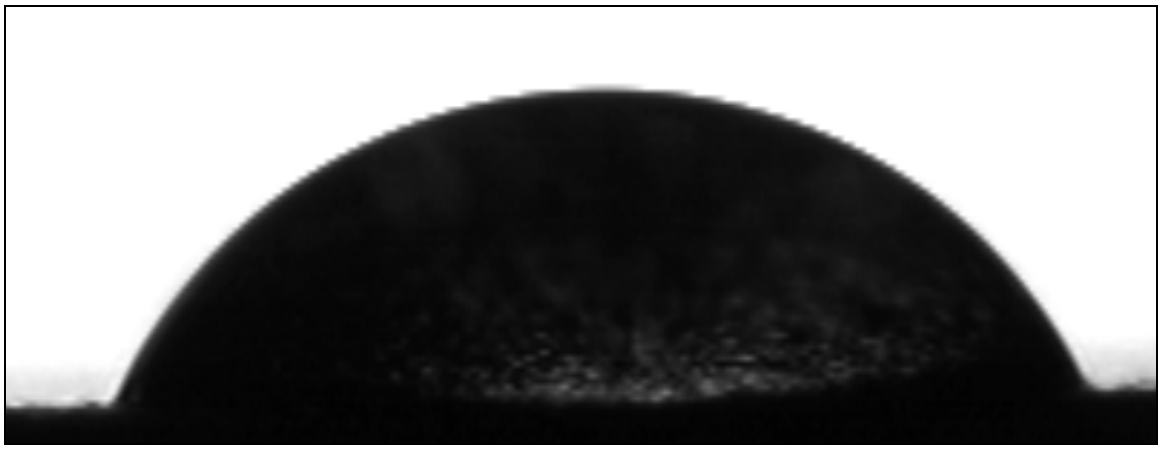


Figure 14: Water on Polished Aluminum. Contact Angle, $\theta \approx 69.5°$



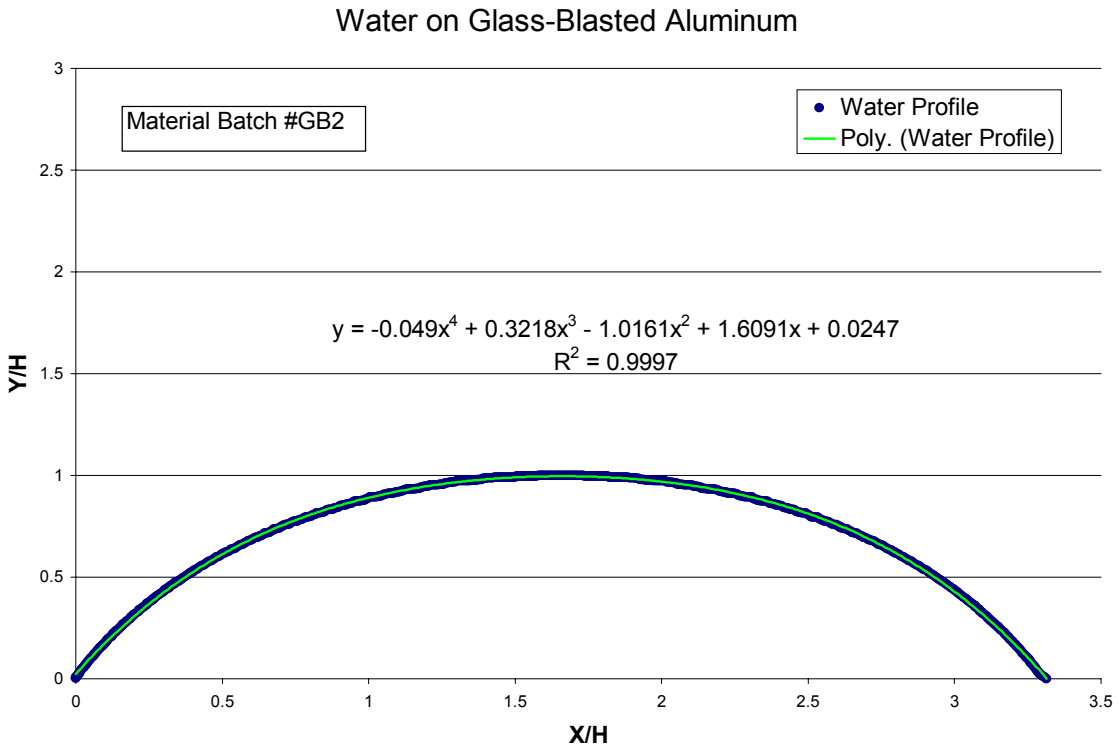
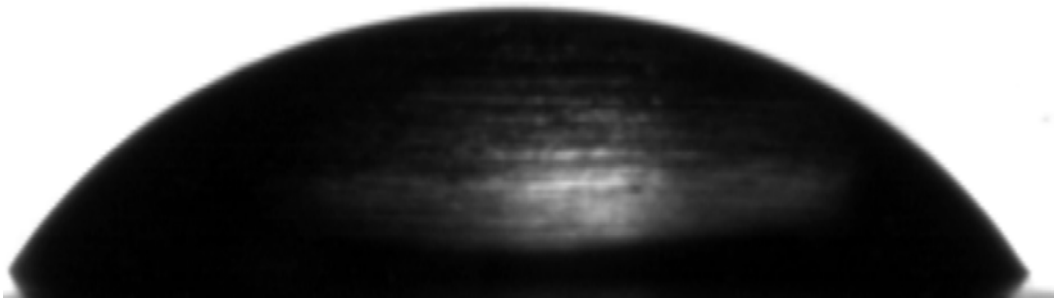


Figure 15: Water on glass-blasted aluminum. Contact angle, $\theta \approx 62.0°$



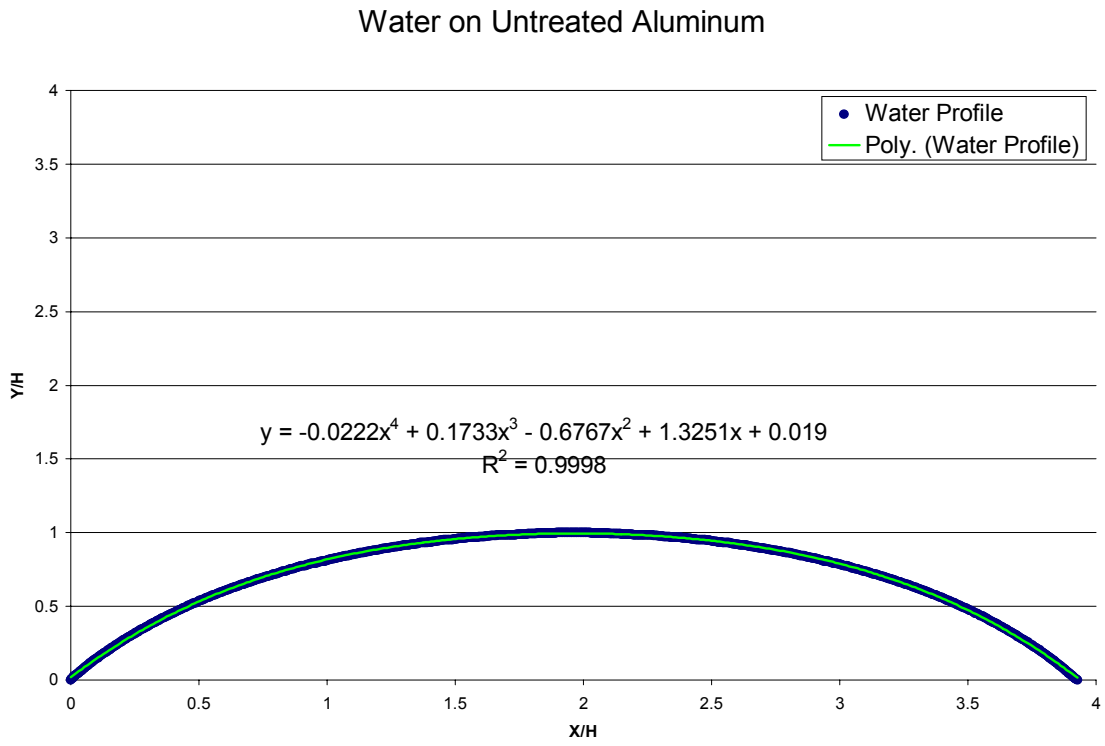
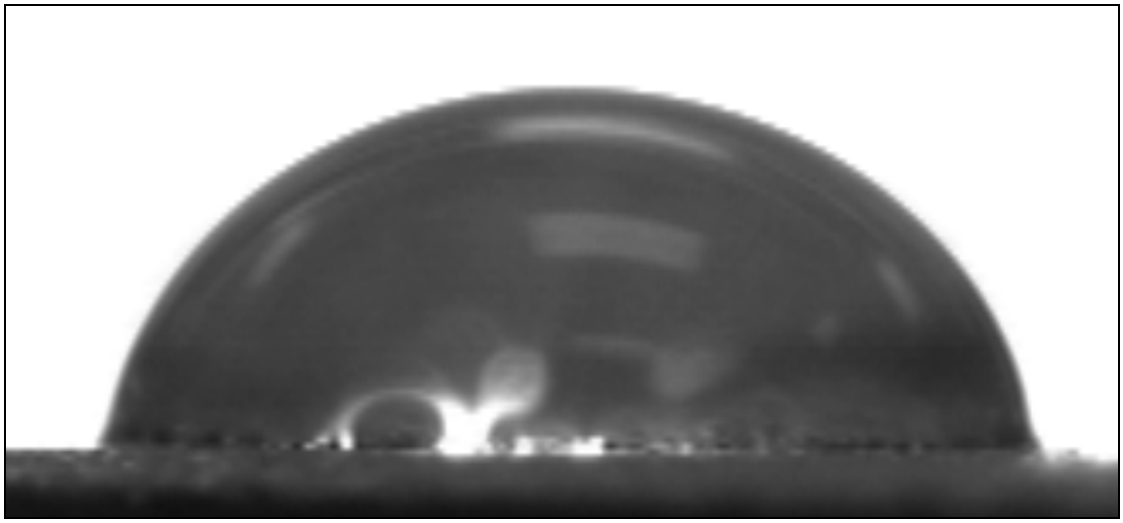


Figure 16: Water on Untreated Aluminum. Contact Angle, $\theta \approx 56.5°$



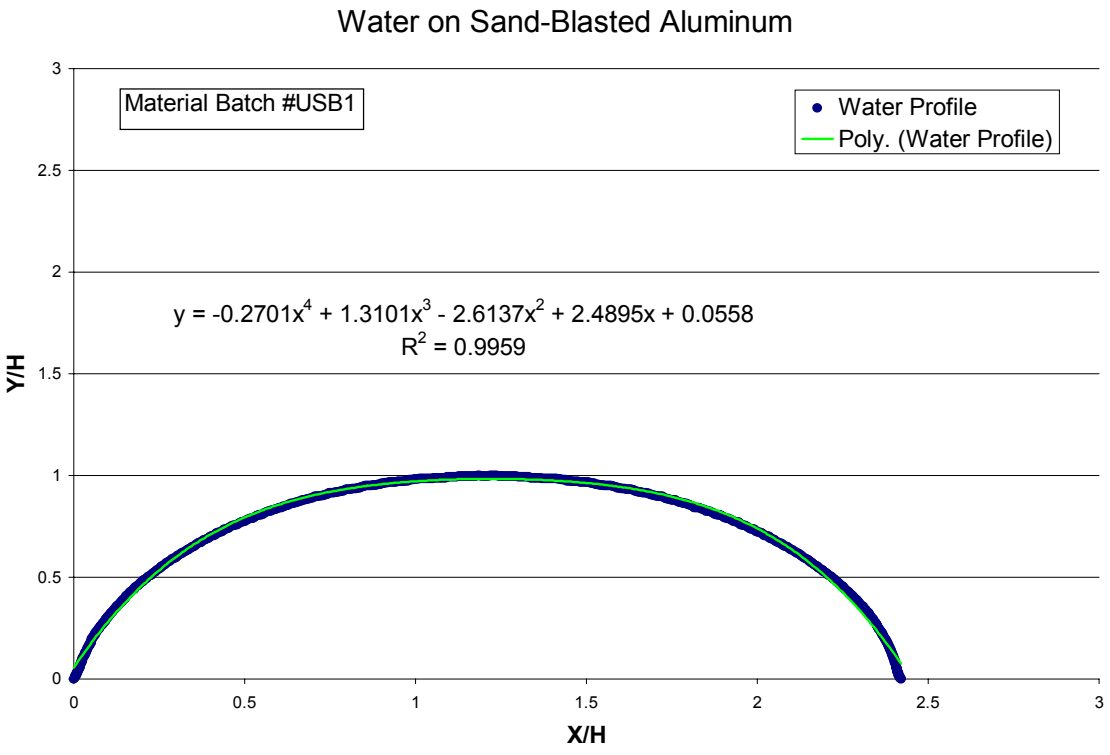


Figure 17: Water on sand-blasted aluminum. Contact Angle, θ ≈ 76.0°

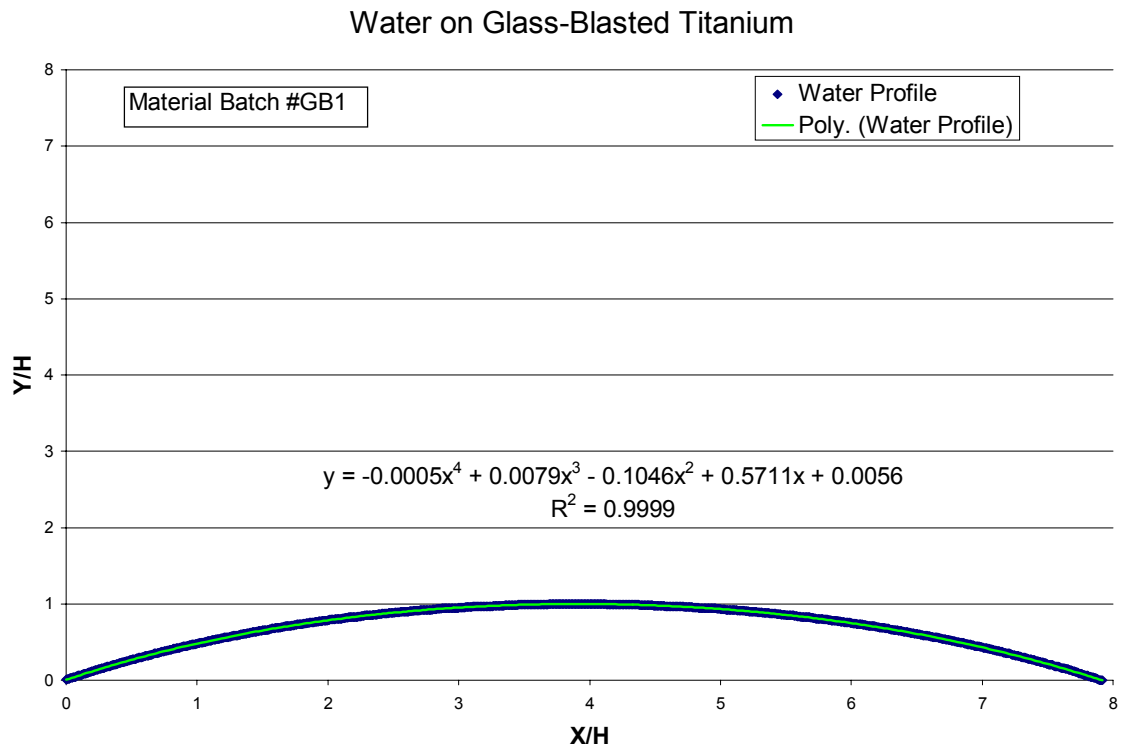
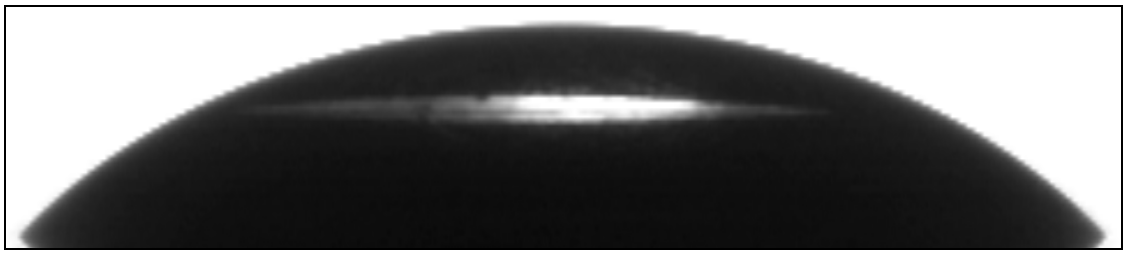


Figure 18: Water on Glass-Blasted Titanium. Contact Angle, $\theta \approx 29.6°$



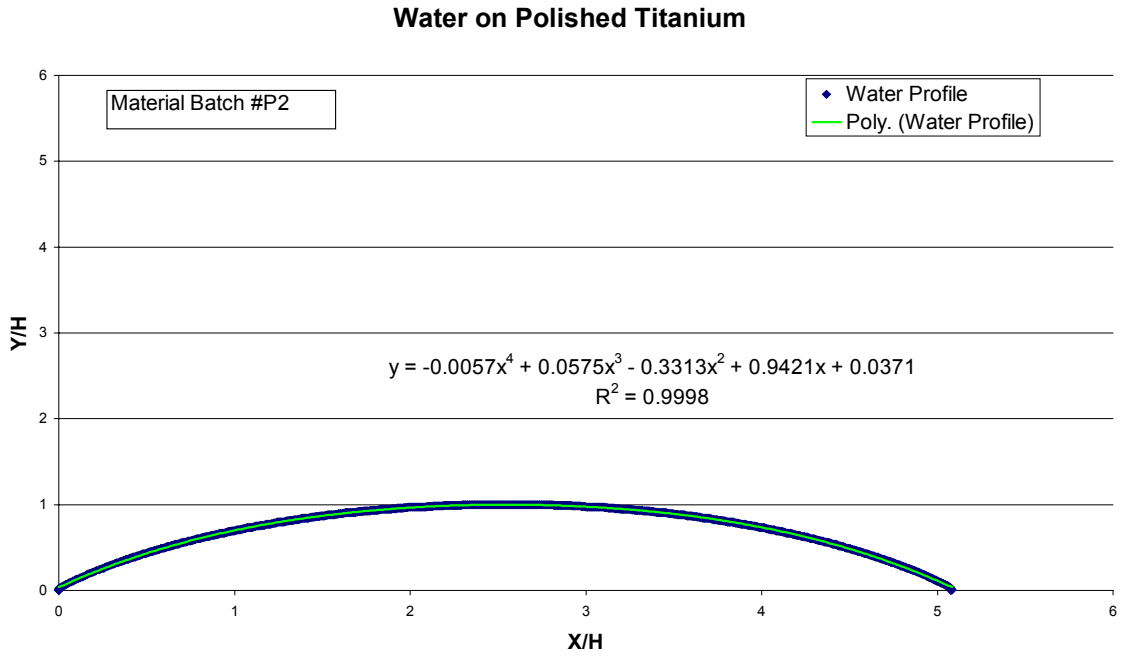
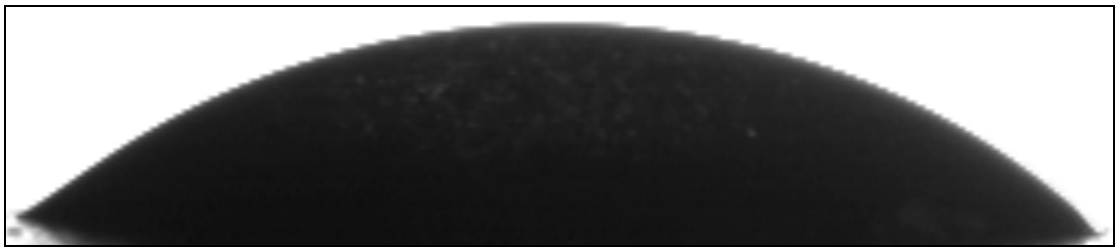


Figure 19: Water on Polished Titanium. Contact Angle, θ ≈ 53.0°



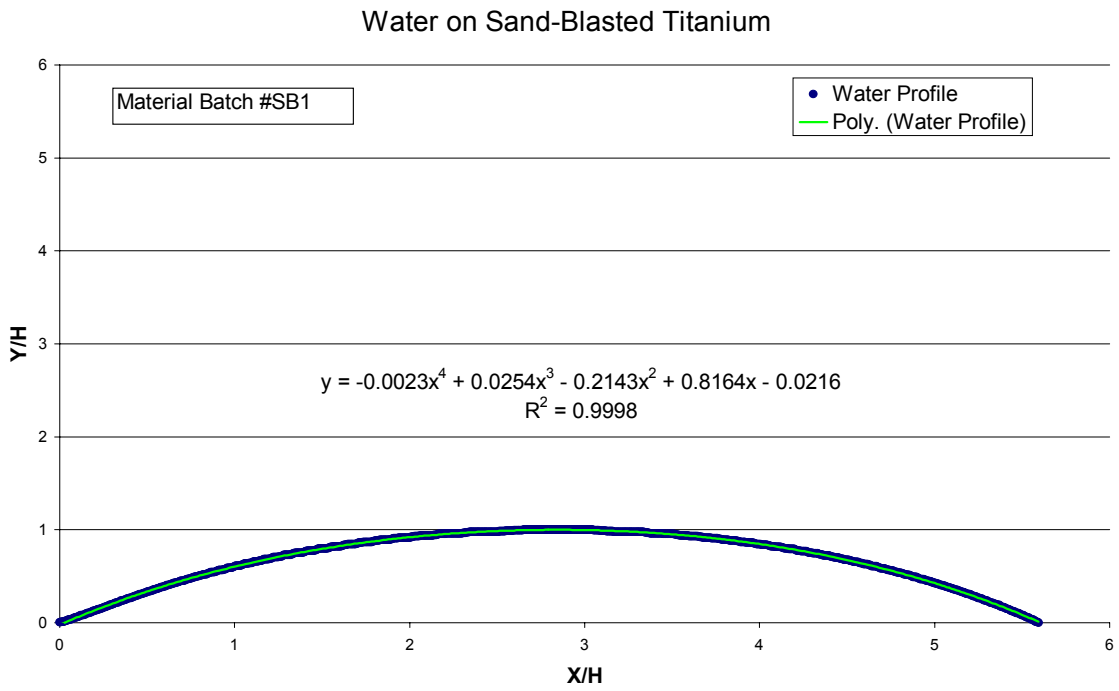
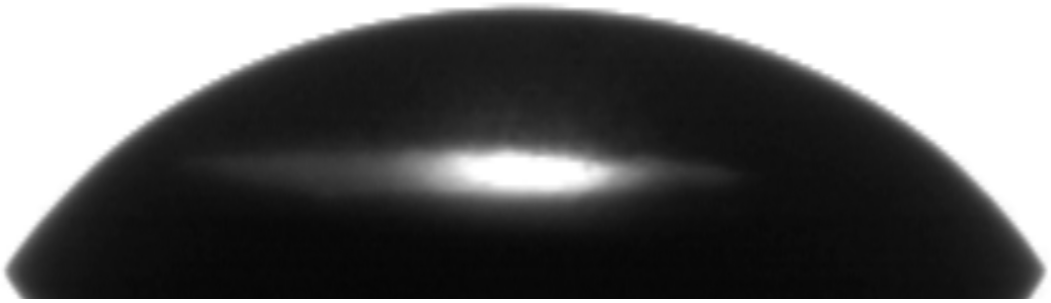


Figure 20: Water on Sand-Blasted Titanium. Contact Angle, $\theta \approx 60.0°$



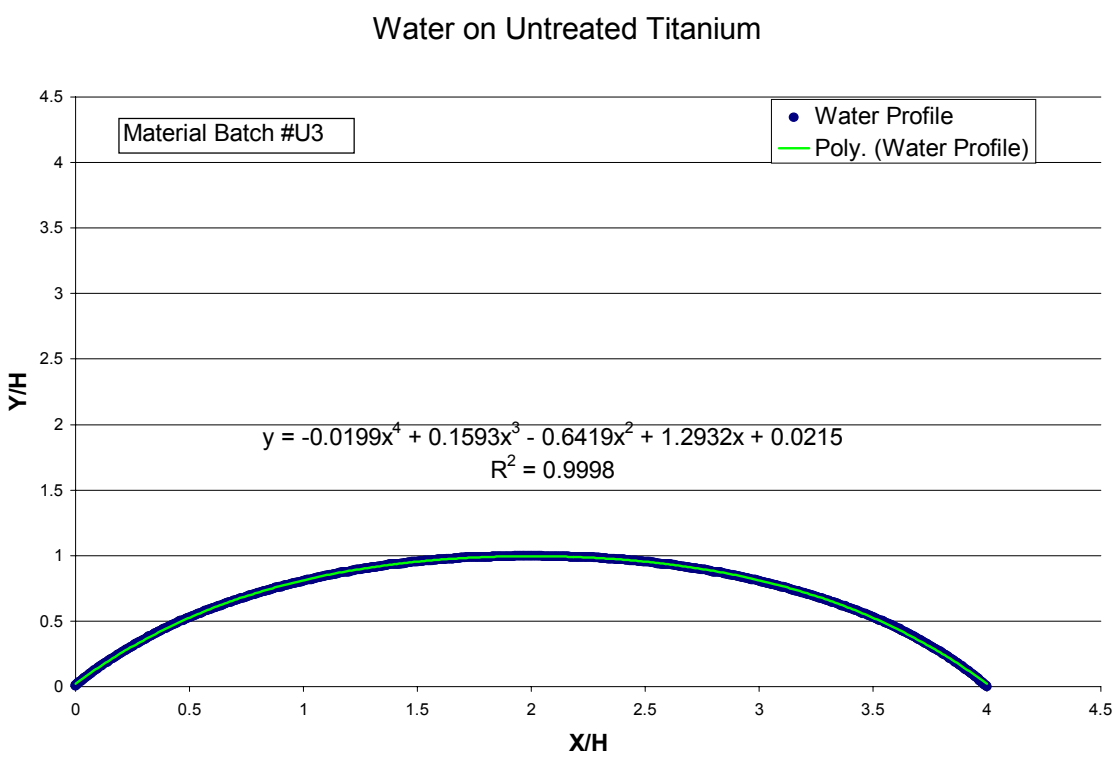


Figure 21: Water on Untreated Titanium. Contact Angle, θ ≈ 55.0°

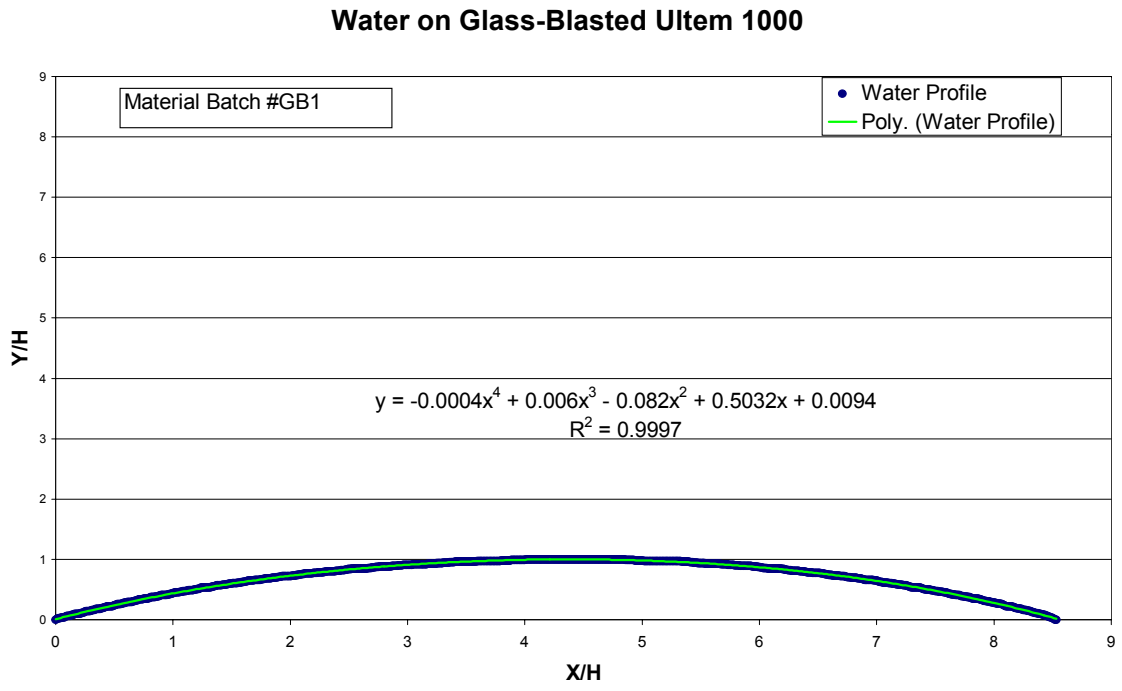
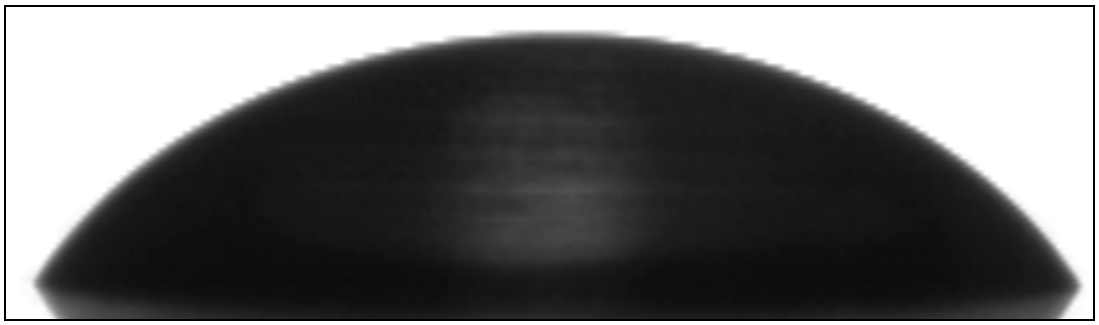


Figure 22: Water on Glass-Blasted Ultem 1000®. Contact Angle, $\theta \approx 28.0°$



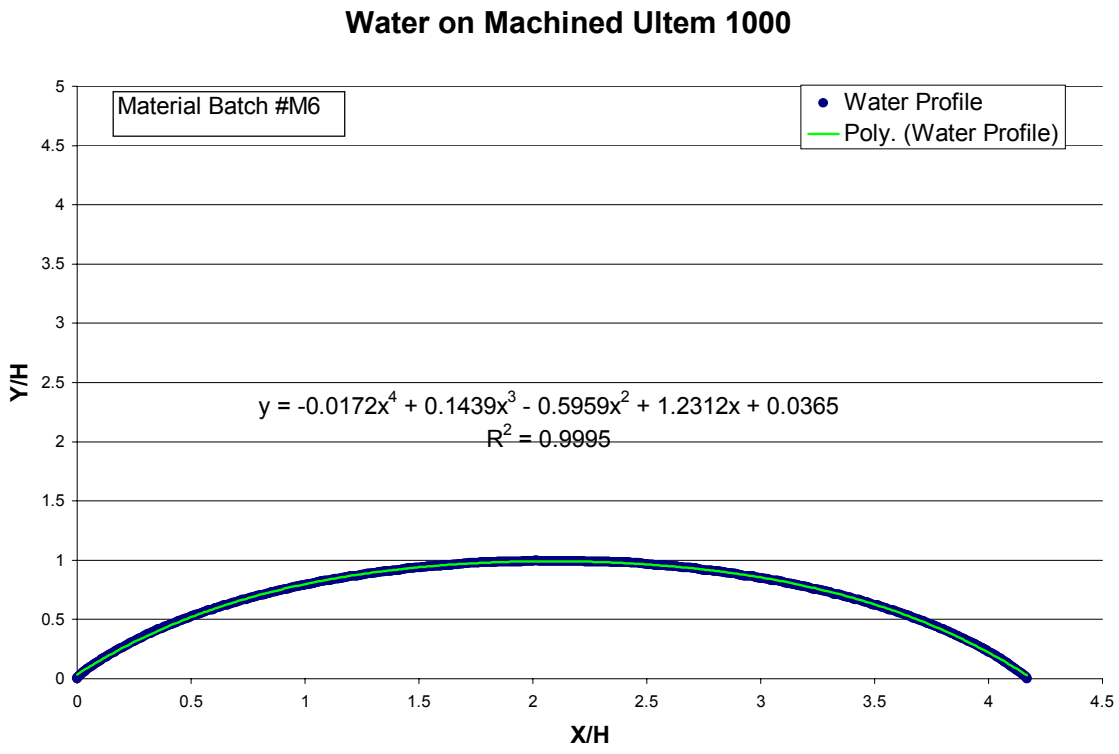
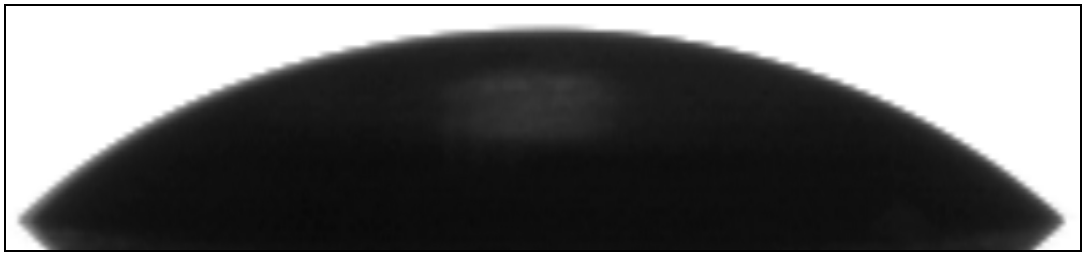


Figure 23: Water on Machined Ultem 1000. Contact Angle, $\theta \approx 74.5°$



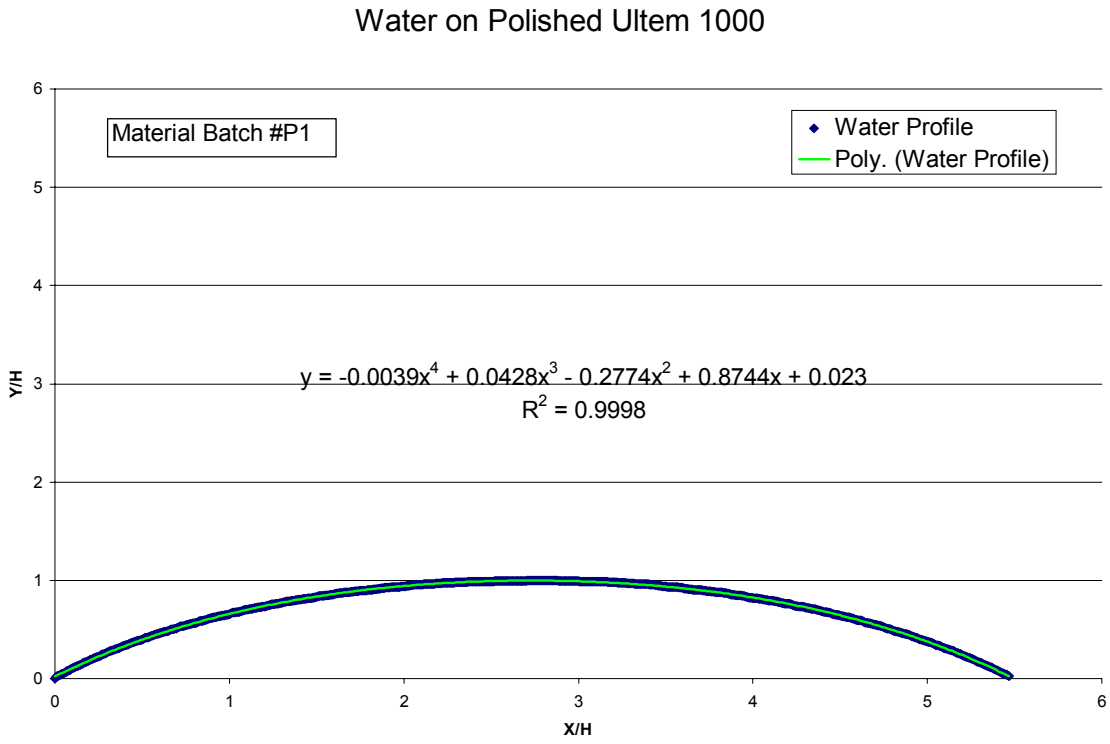


Figure 24: Water on Polished Ultem 1000. Contact Angle θ ≈ 44.0°

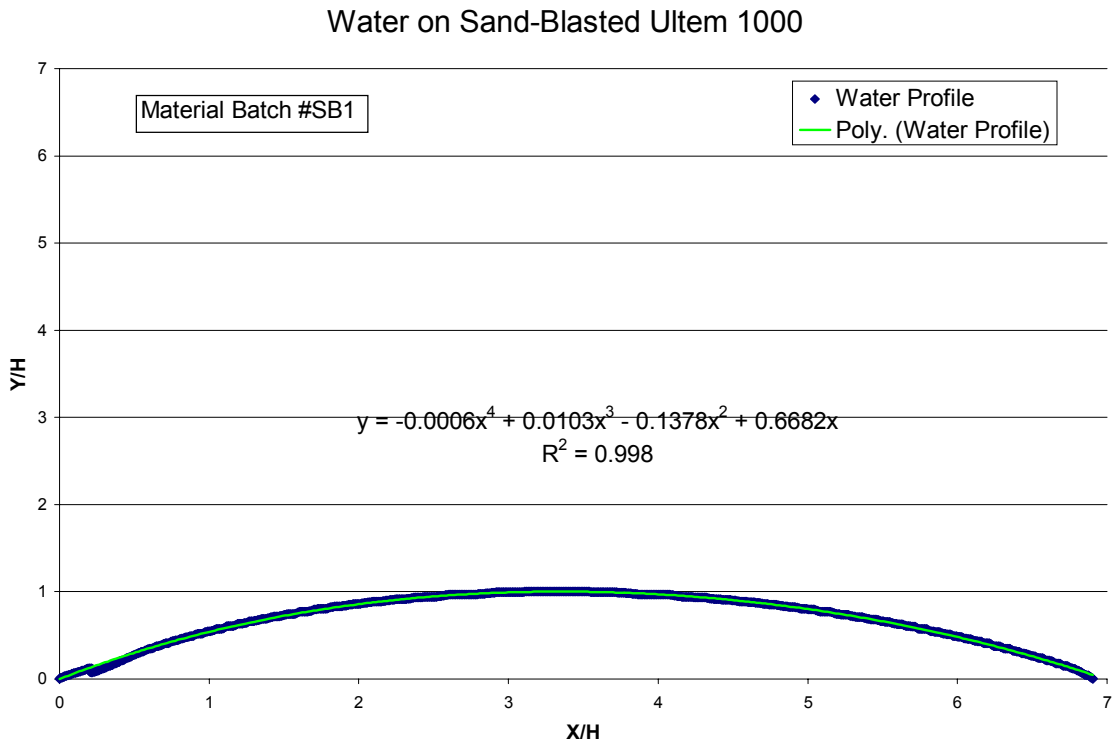


Figure 25: Water on Sand-Blasted Ultem 1000®. Contact Angle, $\theta \approx 30.5°$