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Fourier Transform Infrared Spectroscopy Studies (FTIR) and
Temperature Programmed Desorption (TPD) of Amorphous Solid Water (ASW)

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Fourier Transform Infrared Spectroscopy Studies (FTIR) and Temperature Programmed Desorption (TPD) measurements were used for a preliminary investigation of H_20 water films deposited on decane-covered Pt(111) as a function of deposition time, temperature, and angle.

We performed isothermal sticking/condensation measurements on decane covered Pt(111). At temperatures above 100K, the initial condensation coefficient was less than 1 and decreased with increasing temperature. At a given temperature the condensation coefficient increased monotonically with exposure reaching a temperature dependent asymptotic value. The complicated time dependence of the condensation coefficient is thought to be due to differences between water desorption from bare decane and water desorption from water clusters. The water desorption kinetics also depend on the water diffusion kinetics on the decane substrate. The topology of the water clusters/islands is not known and therefore kinetic modeling of this data is difficult.

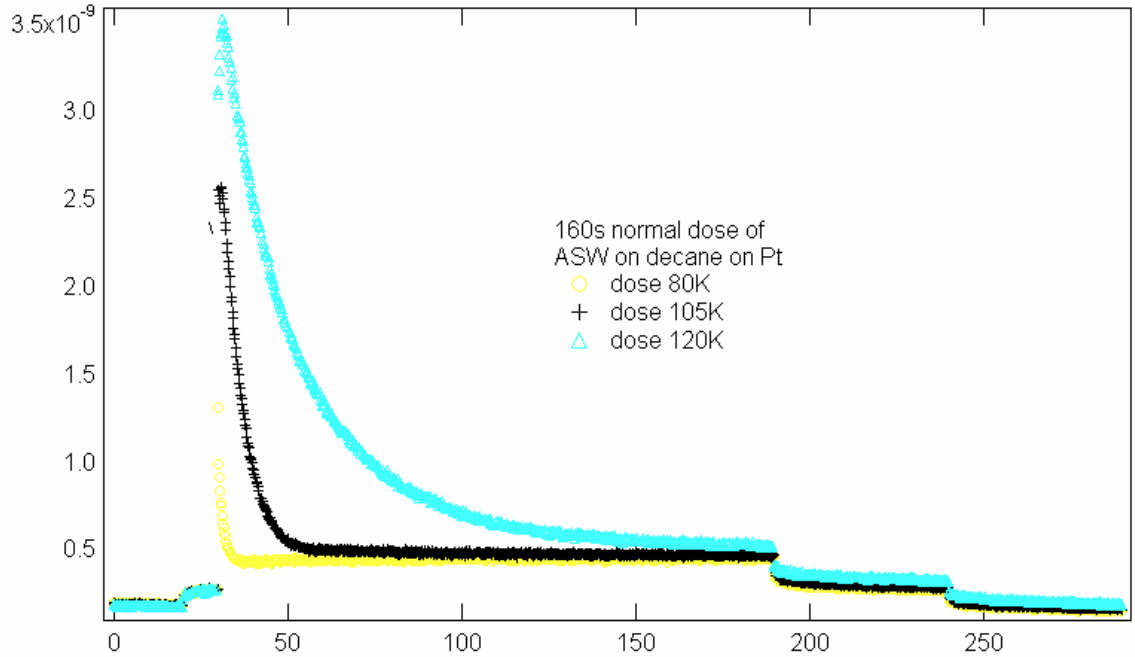
FTIR measurements showed that water films deposited at normal incidence at 80K crystallized after annealing at 146K for 20 minutes. Sticking measurements of water films prepared in the same way showed that the water films dewetted from (clustered on) the decane substrate.

TPD measurements indicated that production of crystalline nuclei is a strong function of deposition T, becoming significant above 100K for water on decane. This result supported the UW hypothesis that the number of crystalline nuclei for water films initially deposited on Au(111) varied with temperature for T>85K.

The EMSL experiments also led to the important new idea that the cantilever in the AFM measurements was redirecting water desorbed from the surface during AFM annealing experiments, an interpretation that was tentatively confirmed by further AFM measurements after the EMSL experiments.

A surprising preliminary result was that water depositions on decane plated Pt(111) near 120K led to non-crystalline clusters.

Some of these results are very briefly described in the Ph.D. dissertation of Jason Donev.



King-Wells measurements for condensation of water on decane coated Pt(111). Water was deposited on the decane surface at normal incidence. The axes are partial pressure of water vs. time in seconds. The initial small rise in pressure that is present for all three curves is due to the gate valve opening which blocks off the molecular beam from the sample. A shutter with very precise timing control is moved out of the way at 30s, and the pressure rises abruptly. For the bottom curve, the substrate was at 80K; the chamber pressure returning to equilibrium very quickly indicates that all of the water condensed on the surface. For dosing at 105K, the middle curve, the pressure took a longer time to return to the same equilibrium background pressure as in the dose at 80K. For the top curve, the pressure took a much longer to reach the equilibrium pressure. From this, it is concluded that water has a non-unitary initial condensation coefficient on decane, starting around 105K and decreasing with increasing temperature.