NANOHOUR

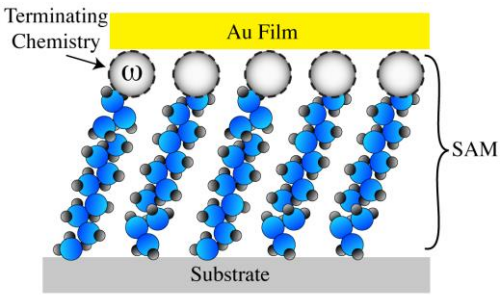
Wednesday, November 13, 2013 3:00 pm

Beckman Institute - Room 3269

Chemically Driven Adhesion via Self-Assembled Monolayers at an Interface

Martha E. Grady, Mechanical Science and Engineering

Graduate Student with Professor Nancy Sottos



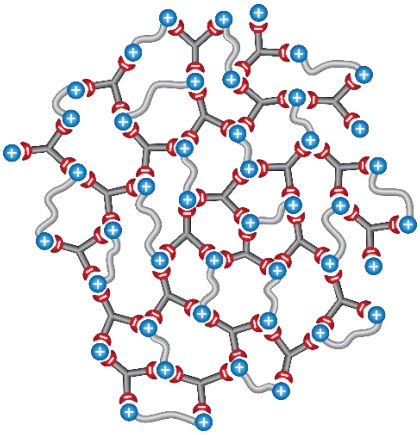
ω	Chemical Name	Shorthand Name
CH_3	Dodecyltriethoxysilane	DTES
NH_2	11-amino-undecyltriethoxysilane	ATES
Br	11-bromo-undecyltrimethoxysilane	BrUTMS
SH	11-mercapto-undecyltrimethoxysilane	MUTMS

Self-assembled monolayers (SAMs) provide an enabling platform for molecular tailoring of the chemical and physical properties of an interface in an on-demand fashion. In this work, we systematically vary SAM end-group functionality and quantify the corresponding effect on interfacial adhesion between a transfer printed gold (Au) film and a fused silica substrate. SAMs with four different end groups are investigated: Dodecyltriethoxysilane (DTES), 11-amino-undecyltriethoxysilane (ATES), 11-bromo-undecyltrimethoxysilane (BrUTMS) and 11-mercapto-undecyltrimethoxysilane (MUTMS). In addition to these four end groups, mixed monolayers of increasing mole percent in solution of MUTMS to DTES are investigated. The adhesive strength of the SAM-mediated interfaces is measured by a non-contact laser-induced spallation method at strain rates in excess of 10^6 s^{-1}. Interfacial stresses are inferred from interferometric displacement measurements and finite element analysis. By making multiple measurements at increasing stress amplitudes (controlled by the laser fluence), the adhesion strengths of Au films transfer-printed on different SAM modified substrates are compared. Varying the end-group functionality drastically alters the adhesion strength of Au films, leading to improved adhesion over transfer printed films on unmodified quartz. We demonstrate an interface strength of 19 MPa, 20 MPa, 52 MPa, and 80 MPa for interfaces prepared with ATES, DTES, BrUTMS and MUTMS respectively. Additionally, increasing incorporation of MUTMS in solution of mixed monolayers with DTES showed increasing interface strength.

Odd-Even Effect on Glass Transition Temperature in Network-Forming Ionic Glass

Ke Yang, Materials Science and Engineering

Graduate Student with Professor Jeffrey Moore



Odd-even effects, the non-monotonic dependency of physical properties on odd/even structural units, are widely observed in homologous series of crystalline materials. However, such alternation has not yet been expected for molecular amorphous materials. Herein, we report the synthesis of a class of network-forming ionic glasses (IG) using multivalent ammonium cations and citrate anions. The glass transition temperatures of the ionic glasses show an alternating pattern with increasing backbone length. To understand the phenomenon's molecular origin, we performed incoherent elastic neutron scattering measurements of the nano-second atomic dynamics. Our results suggest that the molecules' mobility, thus the glass transition temperature, is correlated with their structure symmetry.

Coffee and cookies will be served

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