Nanoconfinement Effects on Molecular Films

Keywords : Surface, Interface, Size effects, Glass transition

Back-ground

Molecules confined in nanometer scale are ubiquitous in nature. Understanding of their properties is an important subject not only in materials science but also in other research fields including interstellar physics and biology.

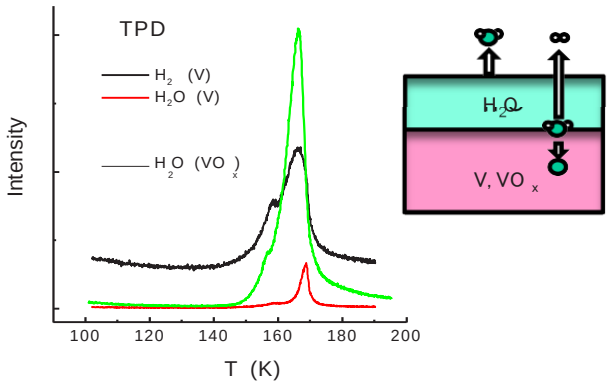
Aim

Physical and chemical properties of liquids in nanoconfined geometry are influenced by finite size effects and interactions with the substrate and free surface. The properties of nanoconfined films are explored from the molecular level using surface and interface analysis techniques.

Advanced Research Topics

Decomposition of nanoconfined molecular films on vanadium

Molecules are frozen at low temperature, and most of them are expected to sublime upon heating. This simple picture does not hold for nanoconfined films formed on a deoxygenated vanadium substrate. As shown in the figure, most of water molecules in nanoconfined films are decomposed to form hydrogen and vanadium oxide at the interface. This occurs because a liquidlike water formed upon heating is reactive against the vanadium substrate. Decomposition occurs for other nanoconfined films such as alcohols, acetone, and hydrocarbons when a liquidlike phase evolves.



Publications

- R. Souda, Phys. Chem. Chem. Phys. **16** (2014) 1095-1100.
- R. Souda, Phys. Chem. Chem. Phys. **17** (2015) 22911-22916.
- R. Souda, J. Phys. Chem. C **120** (2016) 934-943.

Applied area and future prospects

- The glass transition temperatures of nanoconfined films are controlled by the film thickness and substrate wettability.
- Nanoconfined liquids undergo interfacial reaction preferentially on the V substrate.

Issues for technology transfer

- The decomposition of molecules on reactive metal substrates might be useful as a possible source of hydrogen for electric vehicles.

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