Contribution ID: **21** Type: **Talk**

Why is Ice Less-dense and Slippery?

Monday 8 January 2018 13:20 (20 minutes)

As the source and central part of all lives, water is most abundant yet least known. This presentation shares the recent progress [1-6]: (i) correlation of the length scale, structure order, and mass density of molecular packing in water ice; (ii) potential paths for O:H-O bond at relaxation; and anomalies of water ice under (iii) compression; (iv) molecular under-coordination; and (v) thermal excitation. Hydrogen bond (O:H-O) possesses memory and extreme deformation recoverability, which resolves mysteries of: (i) density of ice [7]; (ii) slipperiness of ice [8]; (iii) Mpemba paradox - hot water freezes faster [9]; (iv) Regelation [10] –ice melts under compression and freezes again when the pressure is relieved. Understanding may extend to fields such as water - bio-molecular interaction, water purification, energy management, etc.

1. Sun, C.Q. and Y. Sun, The Attribute of Water: Single Notion, Multiple Myths. Springer Ser. Chem. Phys. Vol. 113. 2016, Heidelberg: Springer-Verlag. 494 pp.
2. Huang, Y.L., et al., Hydrogen-bond relaxation dynamics: Resolving mysteries of water ice. Coordination Chemistry Reviews, 2015. 285: p. 109-165.
3. Zhang, X., et al., Water's phase diagram: from the notion of thermodynamics to hydrogen-bond cooperativity. Progress in Solid State Chemistry, 2015. 43: p. 71-81.
4. Sun, C.Q., X. Zhang, and W.T. Zheng, Hidden force opposing ice compression. Chem Sci, 2012. 3: p. 1455-1460.
5. Sun, C.Q., et al., Density and phonon-stiffness anomalies of water and ice in the full temperature range. Journal of Physical Chemistry Letters, 2013. 4: p. 3238-3244.
6. Sun, C.Q., et al., Density, Elasticity, and Stability Anomalies of Water Molecules with Fewer than Four Neighbors. Journal of Physical Chemistry Letters, 2013. 4: p. 2565-2570.
7. Sun, Q., Raman spectroscopic study of the effects of dissolved NaCl on water structure. Vibrational Spectroscopy, 2012. 62: p. 110-114.
8. Zhang, X., et al., From ice supperlubricity to quantum friction: Electronic repulsivity and phononic elasticity. Friction, 2015. 3(4): p. 294-319.
9. Zhang, X., et al., Hydrogen-bond memory and water-skin supersolidity resolving the Mpemba paradox. Physical Chemistry Chemical Physics, 2014. 16(42): p. 22995-23002.
10. Zhang, X., et al., Ice Regelation: Hydrogen-bond extraordinary recoverability and water quasisolid-phase-boundary dispersivity. Scientific Reports, 2015. 5: p. 13655.

Significance statement

presents quantitative and consistent resolution to the properties of ice friction and ice density from the perspective of hydrogen bond relaxation and electron p[olarization.

Author: Prof. ZHANG, Xi (Shenzhen University)

Co-authors: Prof. SUN, Changqing (NTU, SIngapore); Prof. HUANG, Yongli (Xiangtan University)

Presenter: Prof. SUN, Changqing (NTU, SIngapore)

Track Classification: Phases of Ice