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News Story

Researchers Describe Impact of Nanochannels on Water Diffusion

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By Cameron Chai

The universities of Granada and Barcelona researchers have explained the theory behind the molecular liquid water diffusion through nanochannels for the first time. These nanochannels are very small channels with 1-100 nm of thickness which have been used to analyze the molecule behaviour.

The studies published in Science informed that the desalination and filtration processes of water will be transformed to a higher extent when carbon nanolayers and graphene membranes are used. With a pore size of 1 nm in these substances, rapid water diffusion occurs.

It has been observed over 300 years that water has about 65 abnormal characteristics including water expansion below 4ºC. One of the important features has been the rapid movement of water molecules with an increase in density. This results in the formation of hydrogen bond network within water molecules. A tetrahedral structure will be formed with a central atom surrounded by four molecules from the corners. In fact, the geometrical structures alter with temperature and pressure variations which have not yet been explained clearly.

Professor Francisco de los Santos Fernández from the University of Granada and Giancarlo Franzese from the University of Barcelona have conducted researches on water behaviour limited in between two hydrophobic plates. The researchers observed that the hydrogen bonds compete for their formation and breakage. Hence, molecules may be rearranged cooperatively due to the availability of free molecules, resulting in rapid water diffusion.

Water diffuses macroscopically when nanochannels above 1 nm were used. This is due to the cooperative molecular rearrangement, which results in the breakage of hydrogen bonds within the 1 nm region, whereas when nanochannels below 1 nm were used, the water diffusion improved due to lesser breakage of hydrogen bonds. Hence, these observations state that breakage of hydrogen bonds and cooperative rearrangement within 1 nm regions will have an impact on the macroscopic water properties.

The study was published in Physical Review.

Source: http://www.ugr.es/

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