Accepted Manuscript

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PII:	S1386-1425(18)30154-9
DOI:	https://doi.org/10.1016/j.saa.2018.02.037
Reference:	SAA 15841
To appear in:	*Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*
Received date:	1 July 2017
Revised date:	12 February 2018
Accepted date:	12 February 2018

Please cite this article as: Fabing Li, Zhanlong Li, Ying Wang, Shenghan Wang, Xiaojun Wang, Chenglin Sun, Zhiwei Men , A Raman spectroscopy study on the effects of intermolecular hydrogen bonding on water molecules absorbed by borosilicate glass surface. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Saa(2017), https://doi.org/10.1016/j.saa.2018.02.037

A Raman spectroscopy study on the effects of intermolecular hydrogen bonding on water molecules absorbed by borosilicate glass surface

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Abstract The structural forms of water/deuterated water molecules located on the surface of borosilicate capillaries have been first investigated in this study on the basis of the Raman spectral data obtained at different temperatures and under atmospheric pressure for molecules in bulk and also for molecules absorbed by borosilicate glass surface. The strongest two fundamental bands locating at 3063 cm^{-1} (2438 cm^{-1}) in the recorded Raman spectra are assigned here to the O-H (O-D) bond stretching vibrations and they are compared with the corresponding bands observed at 3124 cm^{-1} (2325 cm^{-1}) in the Raman spectrum of ice I*h*. Our spectroscopic observations have indicated that the structure of water and deuterated water molecules on borosilicate surface is similar to that of ice I*h* (hexagonal phase of ice). These observations have also indicated that water molecules locate on the borosilicate surface so as to construct a bilayer structure and that strong and weak intermolecular hydrogen bonds are formed between water/deuterated molecules and silanol groups on borosilicate surface. In accordance with these findings, water and deuterated water molecules at the interface of capillary have a higher melting temperature.

Keywords Raman spectrum; water; deuterated water; Borosilicate surface; bilayer

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