WATER FEATURES ON SILICA GEL SURFACES INVESTIGATED BY DELAYED LUMINESCENCE

Scordino A.[1,2], Colleoni C.[3], Esposito S.[4], Grasso R.[2], Gulino M.[2,5], Musumeci F.[1,2], Romeli D.[3], Rosace G. [3], Salesi G. [3,6]

[1]Catania University, Department of Physics and Astronomy, Catania, Italy; [2]Southern National Laboratories of Nuclear Physics National Institute, Catania, Italy; [3]Bergamo University, Engineering Department, Bergamo, Italy; [4]Nuclear Physics National Institute, Naples Division, Naples, Italy; [5]Kore University, Faculty of Engineering, Architecture and Physical Education, Enna, Italy; [6]Nuclear Physics National Institute, Milan Division, Milan, Italy.
E-mail: scordino@lns.infn.it

Water is the most important liquid for life. Intense investigations of the hydrogen-bond network structure and associated dynamics has been performed in order to full understand its properties and functions [1]. In previous works [2,3] the possibility to get information on the structures induced in water by specific salts or by temperature by measuring the Delayed Luminescence (DL) of some salt solutions and of water in super-cooled regime was assessed. In particular the low level photoinduced DL signal showed to be significant only when the formation of low-density water (LDW) domains was expected. Moreover results suggested the existence of structures unusually long lasting in time. The dynamics of complex systems such as hydrogen-bonding liquids and their mixtures is one of most active areas of research, and viscous liquid showed effects that indicate the presence of structure for a quite long period [4]. Moreover in recent years the sol-gel process, which leads to the formation of self-assembled (nano) layers on the material surface, has remarkably proved its exceptional potential regarding the synthesis of new coatings with a high degree of homogeneity at molecular level and with outstanding physical-chemical properties [5,6]. Sol–gel techniques based on a tetraethoxysilane (TEOS) precursor leads to the formation of a three dimensional silica network at or near room temperature and water elimination. The structure of silica phase is depending on several parameters among with the water/alkoxide ratio and aging. In this work we report the results of DL measurements performed on gel samples of TEOS. DL induced by UVA laser light was revealed in the 400-650 nm spectral range and temporal decay registered starting 10 μs after the illumination pulse. The responses of samples at different TEOS molar concentration, as well as at different times starting from preparation (natural aging) were compared. Temporal trends of DL decays were analyzed in terms of compressed hyperbola decay laws. Measurements were also performed on changing the temperature from room condition to the supercooled region. Interestingly, the total number of photons collected showed an Arrhenius trend with an activation energy greater than the value obtained in the previously examined case of salt water solutions, and quite similar to the energy values required for breaking and completely separating hydrogen bond.

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