Analysis of the dielectric crossover in liquid water and the possible impact on biological and nanoscopic systems

M. I. Marqués[1,2],* L. M. Maestro[1], E. Camarillo[3], D. Jaque[1], J. García Solé[1], J. A. Gonzalo[1,4], F. Jaque[1], F. Mallamace[5], H. E. Stanley[6], Juan C. del Valle[7], Carmen Aragó[1], Karla Santacruz-Gómez[8], Roberto C. Carrillo-Torres[8]

[1]. Departamento de Física de Materiales, Universidad Autónoma de Madrid, Madrid, Spain
[2]. Condensed Matter Physics Center (IFIMAC) and Instituto Nicolás Cabrera, Universidad Autónoma de Madrid, Madrid, Spain
[3]. Institute of Physics, UNAM, Mexico DF, México
[4]. Escuela Politécnica, Universidad San Pablo-CEU, Madrid, Spain
[5]. Dipartimento di Fisica, Università di Messina and Consiglio Nazionale delle Ricerche - Istituto per i Processi Chimico-Fisici (CNR-IPCF), Messina, Italy
[6]. Center for Polymer Studies, and Department of Physics, Boston University, Boston, MA
[7]. Departamento de Química Física Aplicada, Universidad Autónoma de Madrid, Madrid, Spain
[8]. Departamento de Física, Universidad de Sonora, Hermosillo, México

*manuel-marques@uam.es

Abstract

Several properties of liquid water, including the dielectric constant show a bilinear behavior defining a crossover in the temperature range 50 ± 10ºC between two possible states in water (see Figure 1). The existence of these two states in liquid water plays an important role in nanometric and biological systems. For example, the optical properties of metallic (gold and silver) nanoparticles dispersed in water [1], used as nanoprobes, and the emission properties of CdTe quantum dots (QDs), used for fluorescence bioimaging and tumor targeting, show a singular behavior in this temperature range (see Figure 2). In addition, the structural changes in liquid water may be associated with the behavior of biological macromolecules in aqueous solutions and in particular with protein denaturation.

References

1. Juan C. del Valle, Enrique Camarillo, Laura Martinez Maestro, Julio A. Gonzalo, Carmen Aragó, Manuel I. Marqués, Daniel Jaque, Ginés Lifante, José García Solé, Karla Santacruz- Gómez, Roberto C. Carrillo-Torres and Francisco Jaque (2015): Dielectric anomalous response of water at 60 °C, Philosophical Magazine, DOI: 10.1080/14786435.2014.1000419

Figures

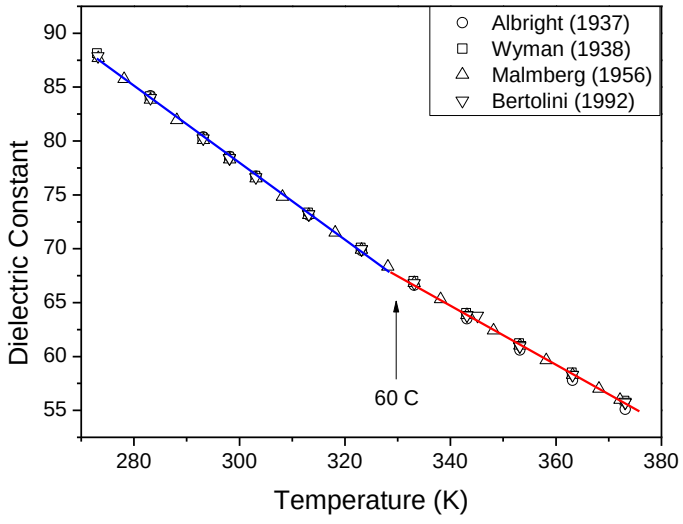

Fig.1 Temperature dependence of the dielectric constant of water at 0.1 MPa**.**

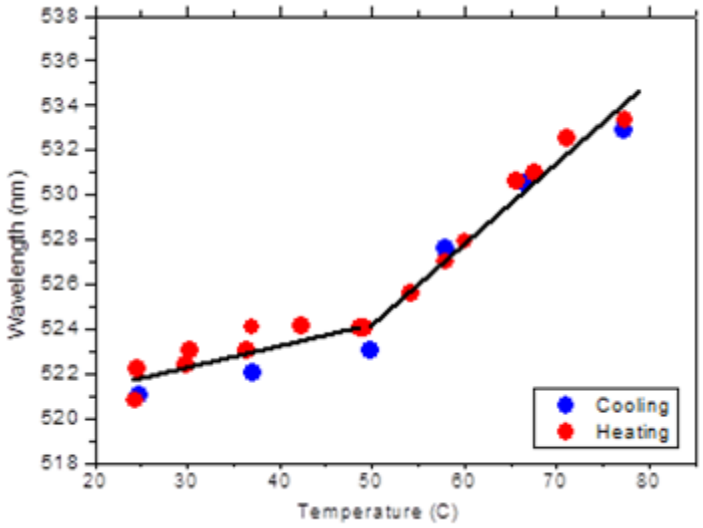

Fig.2 Temperature dependence of the emission peak wavelength in CdTe quantum dots with an average size of 1.2 nm.