

PERSONAL DATA

Ana Ballester Caudet, Pre-doctoral student.

Born 23/03/1985 in Castellón (Spain).

Citizenship: Spanish.

Spoken languages: Spanish (mother tongue), English (Upper intermediate, B2), Italian (Elementary, A2)

Address:

Research laboratory TC1208DL,

Departament de Química Física i Analítica

Universitat Jaume I

12080 Avda. Sos Baynat s/n, Castello, Spain.

Telephone No.: +39 964.72.8075

E-mail: ana.ballester AT qfa.uji.es

EDUCATION

- **Graduated in Chemistry** at Universitat Jaume I in 2008.
- **Master's Degree** in Theoretical Chemistry and Computational Modelling (2008/2010). The Master's Thesis was focused on a comprehensive theoretical study of the effects of the Coulomb interactions on semiconductor nanocrystals properties.

PROFESSIONAL EXPERIENCE

RESEARCH POSITIONS

2009-2013: Pre-doctoral research fellow in Theoretical and Computational Chemistry at Universitat Jaume I (Castelló, Spain).

Ph.D. supervisor: Prof. J. Planelles & Dr. J.L. Movilla.

Title of Thesis: "Theoretical Modelling of electrons, excitons and multiple excitons in Semiconductor Nanocrystals with Axial Symmetry".

2011-2014: Collaboration as a student researcher in the project: "Nanocrystals: Spatial, dielectric and magnetic confinement" at Universitat Jaume I (Castelló, Spain).

2008-2009: Research fellowship at Universitat Jaume I (Castelló, Spain) (8 months).

Title of the investigation: "Theoretical Modelling of quantum dots: dielectric mismatch and external fields applied effects in electronic structure and properties"

Supervisor: Prof. J. Planelles.

RESEARCH EXPERIENCE

A theoretical study on the electronic structure and molecular properties of single shallow donors in nanoscale semiconductor heterostructures has been carried out. In addition to the well-known quantum size effect, the influence on the donor levels of the dielectric confinement (coming from the different dielectric response of the QD and the surrounding medium) has been revealed as a noticeable effect in colloidal quantum dots, as they are usually synthesized in media with a dielectric response rather different to that of the QD material.

The transition bridge between zero-dimensional quantum dots and one-dimensional quantum wires is explored theoretically by means of the construction of the addition energy spectra of nanorods with different lengths. As length increases, the electron-electron interaction role dominates. In the low density limit, density profiles for elongated structures confirm the existence of Wigner crystallization by means of the Spin density-functional theory and Configuration Interaction approach. Furthermore, the existence of inhomogeneous confining potentials in elongated structures leads to the formation of mixed phases, which are composed by the Wigner crystal and the Fermi liquid simultaneously. These results have been calculated by applying an electric field along the longitudinal axis of a dilute nanorod. Also, it is possible to introduce inhomogeneous structural effects by sandwiching between a nanorod of a given material two-end spherical caps of a different material. This structure is known as nanodumbbell. Additionally, simulation of the in-plane and z-polarized modes of the absorption spectra reveals the different correlation regimes occurring in these systems.

PUBLICATIONS

She has collaborated on the following articles:

- “Coupled donors in quantum dots: Quantum size and dielectric mismatch effects”
Physical Review B, 79 195319 (2009), 6 pages
- “From quantum dots to quantum wires: Electronic structure of semiconductor nanorods”
Physical Review B, 80 045324 (2009), 5 pages
- “Mixed correlation phases in elongated quantum dots”
Physical Review B, 82 115405 (2010), 8 pages
- “Configuration interaction approach to Fermi liquid – Wigner crystal mixed phases in semiconductor nanodumbbells”
Journal of Applied Physics, 112 024311 (2012), 5 pages

CONFERENCE ATTENDANCE

- 4th edition of the international and interdisciplinary meeting ElecMol'08 in Grenoble, France (2008).
Type of communication: Poster presentation "Coupled donors in quantum dots: Quantum size and dielectric mismatch effects"
- PLMCN 9th International Conference on Physics of Light-Matter Coupling in Nanostructures in Lecce, Italy (2009). Attendance as a student workshop.
- 1st Workshop on Nanoelectronics for Researchers of the Mediterranean Area in Castellón de la Plana, Spain (2009). Attendance as a student workshop.
- 3rd Workshop on Nanoelectronics for Researchers of the Mediterranean Area in Palma de Mallorca, Spain (2011). Type of communication: Talk. Title: "Mixed phases in elongated quantum dots".
- 40th "Jaszowiec" 2011 International School and Conference on the Physics of Semiconductors in Krynica-Zdrój, Poland (2011). Type of communication: Poster presentation "Mixed phases in elongated quantum dots".