CONTRATOS PREDOCTORALES 2022 SEVERO OCHOA

PROJECT TITLE / JOB POSITION TITLE:

Design of nanoscale phononic logic devices

JOB POSITION RESEARCH LINE:

RL1.- SUSTAINABLE ENERGY CONVERSION AND STORAGE SYSTEMS

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:

The goal of this project is providing a theoretical framework aimed at understanding and controlling the manipulation of heat flux within nanoscale semiconductors. The successful candidate will perform numerical simulations in order to devise realistic approaches for the engineering of a nanoscale thermal diode and a nanoscale thermal transistor, the fundamental building blocks of phononics.

In electronics information is transferred with charge carriers, whose motion can be easily controlled with external fields. This is not the case of phononics, where phonons —the basic particles that carry heat— have no mass or charge: this is why we live in a world of electronic devices and heat is normally regarded as a source of loss.

The goal of this project is reversing this viewpoint and move to a new paradigm where heat can be actively used to transfer energy, thus information, in a controllable way. Nanoscale semiconductors, such as nanowires, ferroelectric thin films, and 2D magnetic materials present multiple advantages over bulk materials to achieve heat rectification or a dynamical control of the thermal conductivity, mostly due to their reduced dimensionality and to the flexibility given by the synthesis techniques. This approach allows envisaging a truly zero-power analog of electronics, as in our world heat is indeed ubiquitous and phononics circuits will effectively need no power supply.

Additionally, learning how to modulate the heat flow have also important consequences in conventional electronics —where heat dissipation at the nanoscale is a major issue— or in devising efficient thermoelectric materials —where materials with low thermal conductivities must be engineered.

This work is framed in on-going collaborations with national and international experimental research groups.

Campus de la Universitat Autònoma de Barcelona
08193 Bellaterra, Catalunya, Espanya
Telf.: +34 935 801 853
Fax.: +34 935 805 729

JOB POSITION DESCRIPTION:

The student will be trained in state-of-the-art methodology to study thermal transport in nanoscale systems. He/she will learn to carry out atomistic numerical simulations to study phonon transport and will operate with increasing independence. The activity will focus on the calculation of the phonon dispersion and the thermal conductivity of functional materials, including semiconducting one-dimensional nanowires and 2D magnetic materials.

The host group routinely works in collaboration with leading experimental groups and the selected candidate will have to be able to work in such a context, as well as pursuing results at the purely theoretical level.

A degree in Physics, Chemistry, Material Science or Nanoscience is required. Experience in computer programming and numerical simulation is a plus, while an excellent proficiently in English is a must.

Creativity, rigor, critical analysis of the data and the ability to work independently are all required qualities to cover this position. Most of all, interest in fundamental scientific research and curiosity will make the ideal candidate for this opening.

GROUP LEADER:

Dr. Riccardo Rurali
Email: rrurali@icmab.es
Research project / Research Group website
https://departments.icmab.es/leem/Grupo/member_pages/riccardo/

Campus de la Universitat Autònoma de Barcelona
08193 Bellaterra, Catalunya, Espanya
Telf.: +34 935 801 853
Fax.: +34 935 805 729