# Preface

Organic spintronics is an emerging research field at the frontier between organic chemistry and spintronics. Exploiting the peculiarity of these two fields, this young branch of spintronics presents a great potential combining the flexibility, versatility, and low production cost of organic materials with the nonvolatility, spin degree of freedom and beyond CMOS capabilities offered by spintronics. While the interest in organic materials was mainly initiated by the expected longer spin lifetime of spin polarized carriers, it has been recently unveiled that new spintronics tailoring opportunities, unachievable or unthinkable of with inorganic materials, could arise from the chemical versatility brought by molecules and molecular engineering. It was shown that the molecular structure, the local geometry at the molecule–electrode interface, and more importantly the ferromagnetic metal/molecule hybridization can strongly influence the interfacial spin properties. This makes organic systems highly promising for the envisaged possibility to engineer at molecular level the spintronic properties of these devices. The increasing attention towards these exciting effects has, during my Ph.D., resulted in the development of a new field called "spinterface," whose aim is to investigate the metal–molecule interface properties for spin polarization manipulation. The work of this thesis follows from the fascinating opportunities predicted and offered by spin hybridization and giving birth to the spinterface field.

This manuscript is divided into three parts. In the first one, a preliminary introduction to the basic concepts of spintronics and the advantages that molecules can bring to this field will be presented. A general state of the art in organic and molecular spintronics will be also reported and a special attention will be given to the physics and experimental evidence of spinterfaces.

The second and third parts of the manuscript will be dedicated to the two main experimental topics investigated during the thesis: self-assembled monolayers (SAMs) and organic semiconductors (OSCs).

The first experimental part will focus on the study of SAMs-based magnetic tunnel nanojunctions. We will see how this system looks like a promising candidate to modulate "at will" the properties of the device since each part of the molecule can be tuned independently, as a “LEGO” barrier. Through the development of these systems we will demonstrate their validity for spintronics and set the bases towards the engineering of the spin polarization properties of spintronic devices at the molecular level.

The second experimental part will focus on the study of organic semiconductors spintronic devices, here $Alq_3$-based spin valves. We will investigate magnetoresistance (MR) effects at room temperature using conventional ferromagnetic (FM) materials. These investigations were done wishing to improve the understanding on the two interfaces and disentangle their contributions on the spin polarization properties of the devices.

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