Magnetic properties of the C_{60}/Fe(001) spinterface interfaced with two-dimensional oxides.

Alberto Brambilla[1], Andrea Picone[1], Dario Giannotti[1], Alberto Calloni[1], Gianlorenzo Bussetti[1], Guido Fratesi[2], Simona Achilli[2], M. I. Trioni[3], Giovanni Vinai[4], Piero Torelli[4], Giancarlo Panaccione[4], Marcon Finazzi[1], Lamberto Duò[1], Franco Ciccacci[1]

[1]Dipartimento di Fisica, Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano, Italy

[2]Dipartimento di Fisica, Università degli Studi di Milano, Via Celoria, 16, Milano, Italy

[3] CNR – National Research Council of Italy, ISTM, via Golgi 19, Milan, Italy

[4] Laboratorio TASC, IOM-CNR, S.S. 14 km 163.5, Basovizza, I-34149 Trieste, Italy

Spintronics is devoted to understanding and governing the injection, manipulation and detection of the electron spin in solid materials, and already provided several concepts and devices currently used in technological applications. More recently, several experimental and theoretical investigations suggested that organic materials can achieve comparable, or even enhanced, performances in spin-based devices and that they can also provide new concepts, leading to the new field of Organic Spintronics [1]. The key role in such systems is played by “spinterfaces”, i.e. interfaces between ferromagnetic materials, that are sources of spin-polarized electrons, and organic layers, which are characterized, in particular, by long lifetimes for spin-polarized electrons. A detailed control over the interface characteristics is therefore of paramount importance to define and, eventually, to tailor physical systems with improved capabilities [2].

In inorganic spintronic systems, it is well-known that the exploitation of thin and ultra-thin oxides in proximity to ferromagnetic metals (for instance, as tunneling barriers in multilayer junctions) directly influences the magnetic properties of the system, very often with beneficial effects. In this talk, I will discuss how the presence of oxygen and ultra-thin oxides may have an influence on spinterfaces. I will focus on the prototypical spinterface between C_{60} fullerene films and Fe(001), presenting atomic insights, as obtained by Scanning Tunneling Microscopy (STM), on the early stages of formation of C_{60} films on differently prepared surfaces of Fe(001) substrates, comparing pristine Fe(001), Fe-*p*(1x1)O, and Cr_4O_5 monolayer/Fe(001), see Fig. 1. Such results will be discussed in terms of the different magnetic coupling developing at the interface, as measured by X-ray Magnetic Circular Dichroism and described by ab-initio simulations. Finally, the near future perspectives of these studies will be briefly addressed.

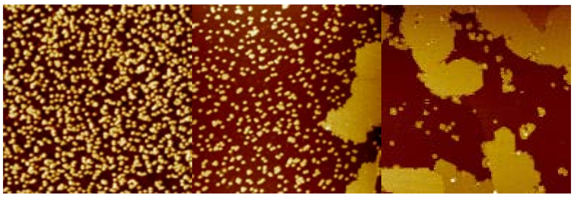

Figure 1. STM images (100x100 nm^2) of 0.5 monolayer C_{60} on a) Fe(001), b) Fe(001)-*p*(1x1)O, c) Cr_4O_5/Fe(001). Images a) and b) are taken from [3].

[1] V. A Dediu, L. E. Hueso, I. Bergenti and C. Taliani, Nature Mater. 8, 707 (2009)

[2] M. Cinchetti, V. A. Dediu and L. E. Hueso, Nature Mater. 16, 507 (2017)

[3] A. Picone, D. Giannotti, M. Riva et al., ACS Appl. Mater. Interfaces 2016, 8, 26418−26424.