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Microscopic magnetic structure at ferro- and antiferromagnetic interfaces revealed by Photoemission Electron Microscopy

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Interface and surface effects play a central role in modern magnet structures. Spin injection across the boundary between magnetic and non-magnetic layers, the surface and interface anisotropy in multilayers, and magnetic exchange coupling and bias are examples for interface phenomena that are utilized in magneto-electronic devices. In particular, the microscopic origin of exchange bias at ferromagnet/antiferromagnet interfaces is still an unsolved problem despite of intense research, driven by the important application of exchange bias in hard disk read-heads and magnetic RAM. Microscopic experiments on magnetically coupled ferromagnet/antiferromagnets using X-ray Photoemission Electron Microscopy (X-PEEM) now provide a new insight into the microscopic processes at this important interface. The role of the domain structure in the antiferromagnet and of uncompensated interface spins will be discussed in particular for the systems Co/NiO and Co/LaFeO₃. Exchange coupling at the antiferromagnet / ferromagnet interface results in an alignment of the spins on both sides of the interface and a domain size dependent local bias. These experiments provide highly desired information on the relative orientation of electron spins at the interface between ferromagnets and antiferromagnets and they hold the key to an eventual understanding of the exchange bias phenomenon. We will also discuss the future application of time resolved X-PEEM to the study of spin-injection and magnetization and spin dynamics in magnetic nanostructures.

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