



	Experiment title: Magnetic nature and local symmetry of Fe in SiC-Fe diluted magnetic semiconductor	Experiment number: HE-2244
Beamline: ID12	Date of experiment: from: 08-NOV-2006 to: 14-NOV-2006	Date of report: 20-FEV-2008
Shifts: 18	Local contact(s): Dr Andrei ROGALEV	<i>Received at ESRF:</i>

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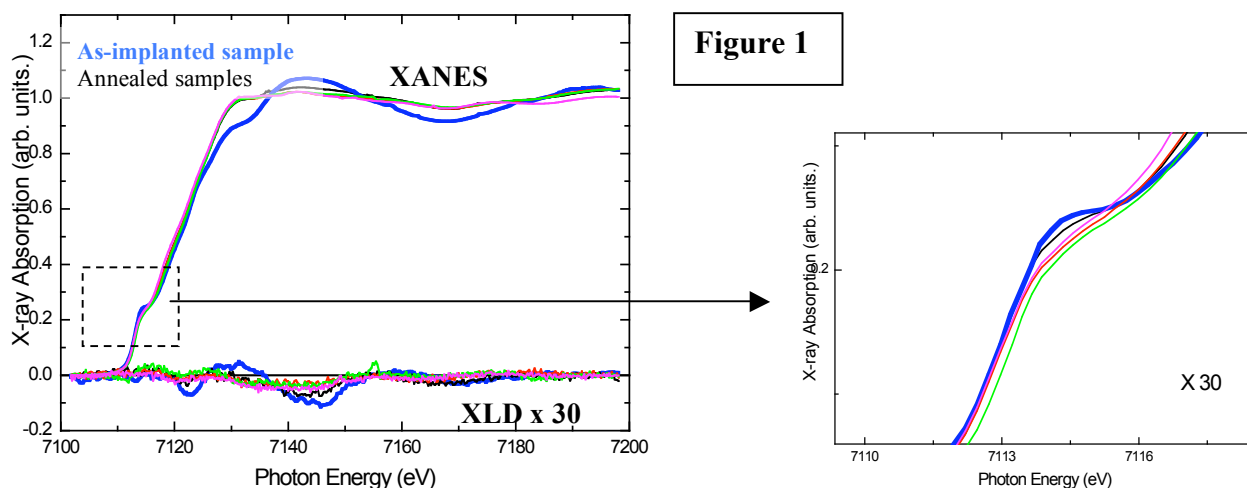
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Report:

The aim of this first experiment was to explore the local structure and symmetry of Fe in the SiC. It has been done by probing the anisotropy of the electronic structure of Fe atoms implanted in as-implanted and annealed monocrystalline 6H-SiC samples using X-ray Linear Dichroism. In the meantime, the magnetic response have been measure by means of XMCD at the Fe K edge.. Knowing that the 6H-SiC matrix is non cubic, we were expected to distinguish the substituted Fe atoms from an eventual parasitic Fe-rich (cubic) phase.

X-ray Linear Dichroism results



As shown in Fig.1, the strongest XLD signal and XANES pre-peaks are obtained from the as-implanted sample showing thus the strongest non-cubic symmetry, but the XLD signal is almost 100 times lower that it must be if all the implanted irons were located at non-cubic sites.

X-ray Magnetic Circular Dichroism results

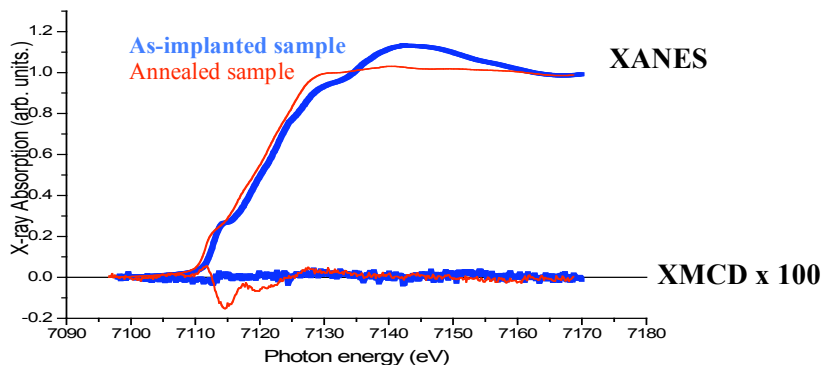


Figure 2

The XMCD spectrum for the as-implanted sample show that Fe is clearly non magnetic. It should be noted that the intensity of the XMCD signal of the annealed sample has the right order of magnitude ($\sim 10^{-3}$). However, the observed signal does not correspond to that of pure iron but is closer to a mixing Fe-Si-C phase. These results do not correspond to a majority of diluted iron atoms. Indeed, in that case, the XMCD signal would be higher and dominant close to the pre-peaks.

Furthermore, recent grazing incidence small-angle X-ray scattering (GISAXS) and preliminary XRD experiments performed at the beamline BM02 (project HS-3341, oct. 2007) and new TEM observations (moiré pattern) on magnetic annealed samples are coherent with Fe₃Si-like nanoclusters with an epitaxial relationship with the SiC matrix.

Further XLD and XMCD experiments could be done after detailed microstructural analysis (TEM, GISAXS, XRD with synchrotron radiation) on magnetic samples were we will be sure that there is no traces of Fe-clustering.s

The allocated beam time (18 shifts) allowed us to do study all the planned samples : 5 (XLD, 300K) + 5 (XMCD, 10K).