SYNCHROTRON RADIATION STUDY OF Mn IMPLANTED SILICON

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Keywords: diluted magnetic semiconductor, spintronic materials, X-ray absorption spectroscopy

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Diluted magnetic semiconductors (DMSs) *based on* III-V and II-VI compounds have been extensively studied for the last fifteen years [1]. However, for practical purpose, silicon-based DMS materials are much more desirable due to their compatibility with existing silicon technology. Recently, Bolduc *et al.* [2] reported room temperature ferromagnetism in Mn ion implanted silicon samples. This finding has generated a lot of new excitements in the DMS community.

Here we present the first synchrotron so called XMCD measurement on the MnSi system to clarify our understanding of the observed room temperature ferromagnetism in the Mn-implanted silicon. In addition, x-ray absorption spectroscopy of Mn $L_{3,2}$ -edge, Mn *K*-edge, and magnetization measurements were also performed on the Mn-implanted silicon. Details of our findings are presented below.

Figure 1 displays the normalized Mn $L_{3.2}$-edge XANES spectra [3] for the as-implanted and annealed samples. These spectra are compared with the Mn $L_{3.2}$-edge XANES spectra of the reference Mn foil and *of* three different manganese oxides.

The normalized Mn $L_{3,2}$-edge XANES and XMCD (denoted as $I_+ - I_-$) spectra for the as-implanted sample and the samples annealed at 300ºC, 700ºC, and 1000ºC are presented in Figure 2. *The* general line shapes of I_+ and I_- are similar for *the* all samples. And it shows a barely vanishing XMCD intensity for the samples investigated, indicating that the average magnetic moment of Mn ions in silicon is almost zero.

Acknowledgements: DCL and WFP would like to thank the National Science Council of Taiwan for financial support under *the grants* Nos. NSC 96-2212-M-032-008-MY3 and NSC96-2212-M-032-012-MY3. LC would like to acknowledge a grant from US Agrecurtural Department.

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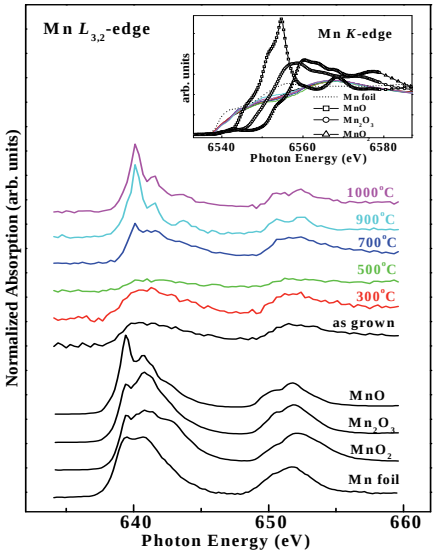

Figure 1 (left). XANES spectra of Mn-implanted silicon sample, as-implanted and annealed. For comparison, XANES spectra of manganese oxide and Mn metal are also shown. In the insert the Mn K X-ray absorption near edge spectra are shown.

Figure 2 (right). Normalized Mn $L_{3,2}$-edge XANES and XMCD spectra for as-implanted sample and samples annealed at 300ºC, 700ºC, and 1000ºC.