Perturbation of Local Electric Field onto Surface Reaction Imaged by Photoemission Electron Microscopy

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Charge transfer from charged defects in oxide to metal plays a key role in catalysis [1]. Although charged states of SiO_2 can be inferred from infrared spectroscopy [2], further study on microscopic electronic interaction of metals with charged oxide inevitably demands photoemission electron microscopy (PEEM) that is highly sensitive to surface electric field [3, 4].

A specimen of n-Si microfabricated with B^+ implantation was prepared in order to control surface electric field. H-termination of the specimen was done by HF treatment. PEEM observation with Hg lamp and micro XPS of the specimen [5] have been done at a branch of BL27SU at Spring-8.

The contrast between p-region and n-region has been reversed by ultrathin oxidation (~1ML). Line profiles across the p-n junction in the images have been analyzed to extract surface potential induced by surface Fermi level pinning, as shown in Fig. 1 [3, 4]. The analysis clearly demonstrates that the contrast reversal reflects oxidation-induced electric field inversion, making surface potential in n-region more positive.

Micro XPS measurements of Si 2*p* have revealed that the ultrathin oxide on n-region is more positively charged than n-region, and support the above analysis. The spectra have in addition demonstrated that UV irradiation induces more positive charging of the oxide on n-region, resulting from the difference in the quality (hole traps) of the oxides. The difference in stoichiometry of the ultrathin oxides can be the cause of that of quality [6]. Mirror electron microscopy can visualize the difference of oxide quality, through inhomogeneity of surface potential on the oxides.

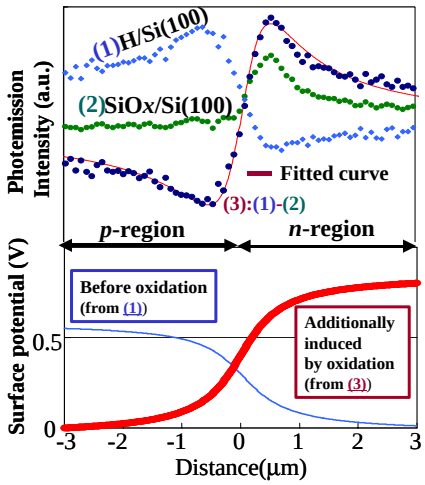

Fig. 1 Line profiles of the PEEM images (upper graph), and the extracted surface potential by analyzing the line profiles (lower graph).

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