東京大学グローバルCOEプログラム　機械システム・イノベーション国際拠点

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New Prospects of Aberration corrected Scanning Transmission Electron Microscopy

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要旨

Aberration-corrected scanning transmission electron microscopy (STEM) enables the structural and chemical characterization of defect structures with sub-Ångström spatial resolution and single atom sensitivity. The reduced depth of field after aberration correction further provides depth sensitivity to obtain three-dimensional information of the sample [1].

Two prominent examples about the application of such techniques will be reported: the localization of single Hf atoms within a multilayered semiconductor device structure[2-4]; and the identification of interstitial point defect configurations in silicon [5]. For both applications, defect structures will be discussed in the framework of their influence on macroscopic properties.

During the final part of the presentation, *in situ* STEM techniques will be discussed that offer novel capabilities to characterize the evolution of atomic-scale defect structures under applied stress, such as heat, electrical fields and currents. First preliminary results will be reported, ranging from the dewetting of ultra-thin films on crystalline substrates, dielectric breakdown of CMOS devices, and pressure-less consolidation of ceramic powders.

1. van Benthem K, Lupini AR, Kim M, Baik HS, Doh S, Lee JH, et al. Three-dimensional imaging of individual hafnium atoms inside a semiconductor device. *Appl Phys Lett* ***87 (2005) 3***
2. Bersuker G, Park CS, Barnett J, Lysaght PS, Kirsch PD, Young CD, et al. The effect of interfacial layer properties on the performance of Hf-based gate stack devices. *Journal of Applied Physics* ***100 (2006) 6***
3. Marinopoulos AG, van Benthem K, Rashkeev SN, Pennycook SJ, Pantelides ST. Impurity segregation and ordering in Si/SiO2/HfO2 structures. *Physical Review B* ***77 (2008) 6***
4. van Benthem K, Pennycook SJ. Imaging and spectroscopy of defects in semiconductors using aberration-corrected STEM. *Appl Phys A-Mater Sci Process* ***96 (2009) 161-9***
5. Oh SH, van Benthem K, Molina SI, Borisevich AY, Luo WD, Werner P, et al. Point defect configurations of supersaturated Au atoms inside Si nanowires. *Nano Lett* ***8 (2008) 1016-9***

主催：　東京大学グローバルCOEプログラム「機械システム・イノベーション国際拠点」
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