

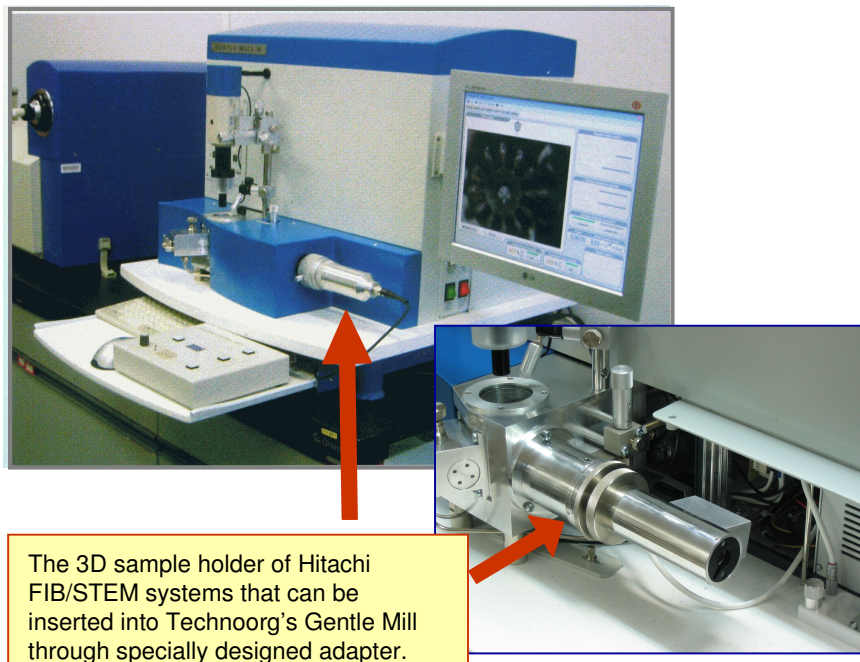
Application Note

Preparation of high performance TEM samples by using Hitachi's FIB/STEM and Technoorg's Gentle Mill

The investigation of the latest 65nm node semiconductor devices requires high-resolution imaging and high-sensitivity analysis of the fine structure on atomic scale. The use of focused ion beam (FIB) systems has recently become the method of choice for site-specific TEM sample preparation. Although the FIB offers advantages over the conventional mechanical and chemical TEM sample preparation, it also has some drawbacks due to its high-energy operation. The high-energy Ga⁺ ion beams used in the FIB systems form defected, amorphous and/or implanted layer in the specimen. Therefore for high-resolution microscopy and high-sensitivity analysis low-energy Ar⁺ ion milling is offered for the final stage of specimen preparation in order to decrease the defected layer.

Hitachi and Technoorg offer a complete solution for site-specific and low-damage specimen preparation technique using Hitachi's FIB/STEM and Technoorg's Gentle Mill system. The Ar⁺ ion milling of FIB sample by Gentle Mill at 200V **reduces the amorphous layer in Si from 28nm to 1.2nm** [1]. The Gentle Mill has been modified to allow the direct insertion of the FIB-STEM/TEM compatible specimen rotation holder. Thus the preparation time can drastically be decreased (FIB milling time: about 60 minutes, low-energy Ar⁺ ion milling time: 3 minutes [3]) that meets the requirement of the up-to-date high-throughput analysis of semiconductor devices.

Hitachi FIB/STEM-compatible dedicated low-energy ion mill



The 3D sample holder of Hitachi FIB/STEM systems that can be inserted into Technoorg's Gentle Mill through specially designed adapter.

Hitachi High-Technologies

TEM/STEM/SEM

HT-7700
HD-2000/2300/2300A/2700
HF-2000/2100/2200
HF-3000/3300
H-7500/7600/7650
H-8000/8100
H-9000/9500
S-5000/5200/5500

FIB FB-2000
FB-2000A
FB-2100
NB-5000

References:

1. T. Yaguchi et al.: A method for 3 dimensional structural and compositional imaging of nano-materials, Proceedings of Microsc Microanal 12 (Supp 2) 2006, 528-529
2. T. Yaguchi et al.: Development of sample preparation method for three-dimensional structural and elemental analyses of a specific site and its application, Proceedings of MRS Fall Meeting, Boston, USA, Nov. 26-30, 2006.
3. T. Yaguchi et al.: A site-specific structure analysis of a 65nm node device using an FIB-STEM/TEM system, Hitachi EM News, 2007, pp 25-30
4. T. Yaguchi et al.: A method for site-specific specimen preparation of Si device after 65nm node technology using FIB-STEM/TEM system, Proceedings of Microsc Microanal 13 (Supp 2) 2007, 790-791