DATA REPOSITORY

CMOS-compatible manufacturability of sub-15 nm Si/SiO_2/Si nanopillars containning single Si nanodots for single electron transistor applications

J. von Borany*, H.-J. Engelmann, K.-H. Heinig, E. Amat, G. Hlawacek, F. Klüpfel, R. Hübner, W. Möller, M.-L. Pourteau, G. Rademaker, M. Rommel, L. Baier, P. Pichler, F. Perez-Murano, and R. Tiron

Semiconductor Science and Technology **38**, 055011 (2023)
doi: 10.1088/1361-6641/acbe5d

*Corresponding author:
Helmholtz-Zentrum Dresden-Rossendorf (HZDR), D-01328 Dresden, Germany
Phone: +49 351 260 3374 Email: j.v.borany@hzdr.de

Description and References to Figures and Tables:

Remarks: The TEM, EFTEM, HIM micrographs represent the as-recorded images without any markers or legend, included in the final publication figures. Datasets are saved as .csv

Publication Reference	Description	Image/Data/ File-Reference	Type
Fig. 3a	Drain-source current of the SET operating at RT as a function of the thickness of the tunnelling oxides.	Figure_3a.tif Fig-3a_data.csv	Image Data
Fig. 3b	Drain-source current of the SET operating at RT as a function of the pillar diameter for a circular Si ND.	Figure_3b.tif Fig-3b_Data.csv	Image Data
Fig. 5	Si excess depth profile after ion-beam mixing as obtained from TRIDYN simulations.	Figure_5.tif Fig-5_Data.csv	Image Data
Fig. 6	Set of kMC simulations of SiO_x phase separation and Si ND formation in cylindrical Si/SiO_x/Si nanopillars of different diameters.	Figure_6.tif	Image
Figs. 8a-c	Sequence of Si-plasmon-loss-filtered TEM micrographs of an Si/SiO_2/Si stack, from top to bottom: (a) as deposited, (b) ion-irradiated, (c) annealed.	Figure_8a-c.tif	Image
Fig. 8d	Normalized Si depth profiles as extracted from grey-scale values of EFTEM images Figs. 8a-c.	Figure_8d.tif Fig-8d_Data.csv	Image Data
Fig. 9a	HIM micrographs of pillar arrays 1C after annealing.	Figure_9a.tif	Image
Fig. 9b	HIM micrographs of pillar arrays 1F after annealing.	Figure_9b.tif	Image
Fig. 10a	HIM image of NPs after annealing in an N_2/O_2 = 99/1 vol.% atmosphere.	Figure_10a.tif	Image
Fig. 10b	EFTEM image of an individual NP of Fig. 10a using Si-plasmon-loss filtering.	Figure_10b.tif	Image

Fig. 10c	EFTEM image of the NP from Fig. 10b using SiO_2-plasmon-loss filtering.	Figure_10c.tif	Image
Fig. 11a	NP diameter for pillars of array 1 (CD30) after RIE etching and subsequent RTA at 1050°C.	Figure_11a.tif Fig-11a_Data.csv	Image Data
Fig. 11b	Reduction of the intermediate oxide thickness for stacked Si/SiO_2/Si pillars of various diameters and ~ 80 nm total height.	Figure_11b.tif Fig-11b_data.csv	Image Data
Fig. 12a	Si-plasmon-loss-filtered EFTEM images before a single plasma oxidation	Figure_12a.tif	Image
Fig. 12b	Si-plasmon-loss-filtered EFTEM images after a single plasma oxidation	Figure_12b.tif	Image
Fig. 12c	SiO_2-plasmon-loss-filtered EFTEM image of the pillar shown in Fig. 12b.	Figure_12c.tif	Image
Figs. 13a-c	Si-plasmon-loss-filtered EFTEM micrographs showing isolated NPs (IPs) of nominal 50 nm, 40 nm and 30 nm diameter, fabricated the process flow sketched in Figure 7 of the paper.	Figure_13a-c.tif	Images
Figs. 13d-f	Enlarged details of Figs. 13a-c showing the oxide region with Si inclusions.	Figure_13d-f.tif	Images
Fig. 13g	IP30 pillar fabricated by RIE over-etching	Figure_13g.tif	Image
Fig. 14	EFTEM (Si-plasmon-loss-filtered) image of a NP of about 11 nm in diameter with a single almost spherical Si ND (diameter 2.5 nm) embedded in the oxide.	Figure_14.tif	Image
Fig. 15a	Influence of vertically asymmetric ND position on the SET current	Figure_15a.tif Fig-15_data.csv	Image Data
Fig. 15b	Influence of the laterally shape of NDs on the SET current	Figure_15b.tif Fig-15b_Data.csv	Image Data
Table I	Values for the effective NP diameter, the oxi-de thickness and number of NDs in the pillars of Fig. 13	Table_I.csv	Data

Used Abbreviations:

EFTEM	energy-filtered transmission electron microscopy
FET	field-effect transistor
HIM	helium ion microscope
kMC	kinetic Monte-Carlo (simulation tool)
ND	nanodot
NP	nanopillar
SET	single electron transistor
RIE	reactive ion etching

RT	room temperature
RTA	rapid thermal annealing
TEM	transmission electron microscope
TRIDYN	computer program for the dynamic simulation of ion irradiation effects in multi-component targets