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Selective Epitaxial Growth of Si and in Situ Deposition of Amorphous- or Poly-Si for Recrystallisation Purposes

L. KARAPIPERIS, G. GARRY, D. DIEUMEGARD
Laboratoire Central de Recherches, THOMSON-CSF
B.P. 10 Orsay, FRANCE

Selective Epitaxial Growth (SEG) of Si is an area of active materials research because of the important applications it lends itself to (Ref. 1, 2, 3). Lateral isolation of active areas on bulk Si, an alternative to LOCOS, is such a potential application. Another domain of great interest is the use of SEG for SOI and 3-D integration applications. The usual approaches in seeded Solid Phase Epitaxy (SPE) and Zone melting Recrystallisation (ZMR) involve, first of all, the etching of seeding zones in the insulating layer (usually SiO_2) which will provide the isolation from the bulk. An amorphous- or poly-silicon layer is then deposited by LPCVD, as well as capping and variable reflectivity layers, if needed. The resulting structure presents a number of drawbacks : a) It is not planar, which may pose problems in various processing steps after recrystallisation. b) The thin layer to be recrystallized is in direct contact with the bulk substrate in the seeding zone and, as a consequence, some melting of the substrate will occur there. c) Recrystallisation fronts often have difficulties climbing over steps.

We have studied SEG on (100) Si under Reduced Pressure CVD in a RF-heated horizontal reactor over a range of pressures (12-100mb) and temperatures (850°-950°C) using SiH_2Cl_2 as carrier gas mixed with variable proportions of HCl for nucleation control. Epitaxial growth velocity has been studied as a function of local Si/SiO_2 surface ratio, and faceting as a function of seeding-zone orientation. Faceting is practically eliminated with the use of Reactive Ion Etched seeding windows parallel to the (100) crystalline direction (Fig. 1), and planarised structures are thus obtained.

Another problem we have tackled is that of contamination of the interface between the amorphous- or poly-Si layer to be recrystallised and the underlying Si/SiO_2 structure. In order to minimise contamination, the sample was not extracted from the CVD reactor after SEG, but remained in a hydrogen ambient at reduced pressure till it cooled down sufficiently to perform the in situ amorphous- or poly-Si layer deposition at pressures below 1 Torr from pure SiH_4 source gas (Fig. 2). Samples thus prepared will be used for e-beam and laser ZMR, and for Solid Phase Epitaxy.

ACKNOWLEDGEMENTS

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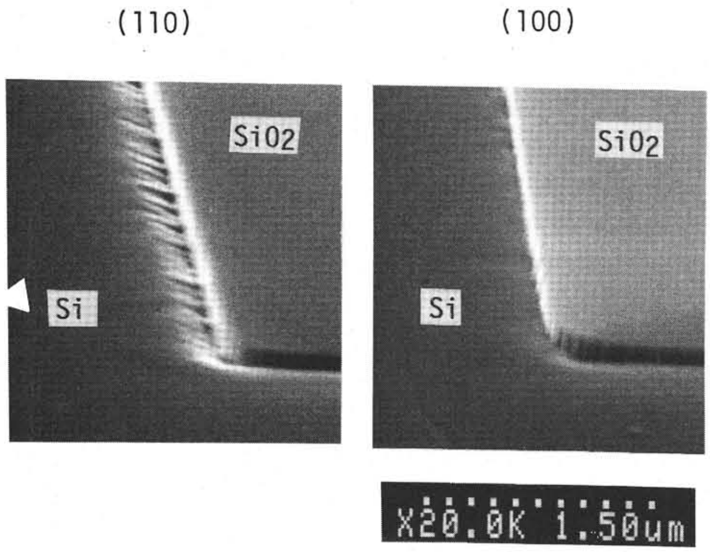

Fig. 1 - Dependence of faceting on seeding window orientation under RPCVD conditions (26 mb 950°C).

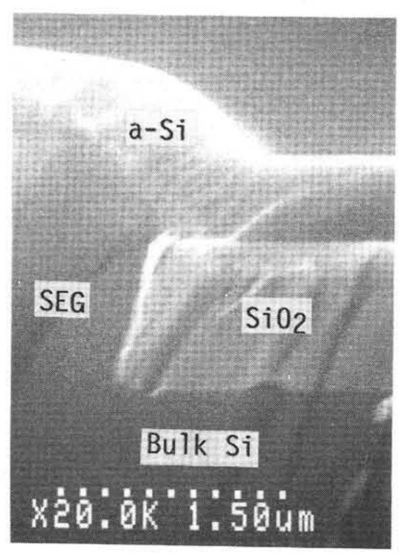

Fig. 2 - SEG + in situ a-Si deposition.