Anisotropic surface stress in one-dimensional Si(110)-“16×2”

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Silicon surfaces produce unique stress distribution corresponding to the reconstruction based on dangling bond reduction and adatom formation. It is known that a reconstructed Si(110)-“16×2” surface has a chiral structure (L or R) with one-dimensional mono-atomic steps and pentagon pair rows along [1-12] and/or [-112] directions. The chiral structures are generated as a double domain on the surface as well as a combination of both, however, the mechanism of double-domain formation has not been elucidated, and no method has yet been established to reproducibly and selectively control the chirality of one of them.

Here we show the internal surface stress contrast between reconstructed Si(110)-“16×2” and hydrogen-terminated Si(110)-1×1 surfaces. And we show that an externally uniaxial stress-driven Si(110)-“16×2” structure controls the chiral one-dimensional reconstruction.

We found the Si(110)-“16×2” reconstruction has anisotropic tensile stress intrinsically on the bulk Si(110)-1×1 structure. Furthermore, we were able to find selectively the chiral reconstructed structure. Our results demonstrate how to form homochirality on the Si surface, which consists of a one-dimensional chiral structure. We anticipate our results to be starting point for the establishment of a new highly efficient and stable method for the complete separation of chiral substances. It is also expected to have a significant ripple effect that will directly lead to innovations in novel optical silicon devices.

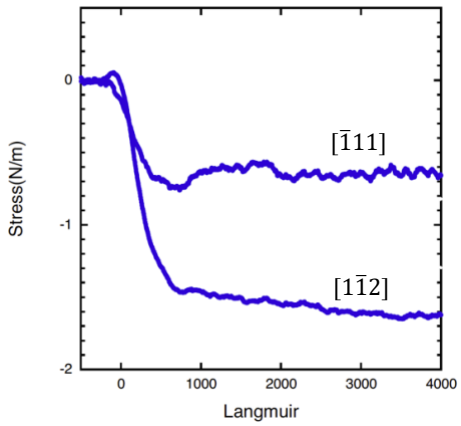

Fig.1 Evolution of surface stresses during atomic hydrogen exposure of Si(110)-“16×2”.