

# Reconstruction of vicinal SiC surfaces in liquid silicon at high temperature

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## Jury :

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**Abstract:** The accurate description, understanding and control of the high-temperature behaviour of the interface between a 4H-SiC single crystal and a liquid phase are essential for the future development of SiC solution growth. The various parameters that cause morphological instabilities, such as step-bunching and micro-faceting, remain unclear. This thesis aims to provide new information on the origin of instabilities at the SiC/liquid interface during growth. First, a specific sessile drop approach was designed, combining experiments and numerical simulation. An isothermal environment was realised, in which an electromagnetic field was used as an actuator for carbon transport and thus enabled the transition from transient surface dissolution to stationary dissolution. All technical implementation issues were critically discussed and optimised. Next, the reconstructions of vicinal and concave surfaces of 4H-SiC {0001} in pure liquid silicon were studied in-depth, considering the effect of external parameters (time, temperature) and intrinsic properties (crystallographic orientation, polarity). In general, a higher surface free energy leads to more pronounced faceting on the Si side, while a higher Ehrlich-Schwoebel barrier leads to stronger step-bunching on the C side. By growing on such reconstructed surfaces, we have clearly demonstrated total reversibility of bunching-debunching of the macrosteps on the C face, while the transition to a faceted surface is irreversible for the Si face. Moreover, an original sandwich experiment showed that the difference in surface free energy between the two polarities could generate carbon transport. Finally, using the same sessile drop configuration, we provided a new determination of the solubility of carbon in liquid silicon over a wide temperature range (1500 °C~2200 °C), clarifying the wide discrepancy in the literature.