From atomic level investigations to membrane architecture: An in-depth study of the innovative 3C-SiC/Si/3C-SiC/Si heterostructure

Due to its outstanding physico-chemical properties, the cubic polytype of silicon carbide (3C-SiC) gained significant interest in several fields. In particular, this material emerged as a potential candidate to replace Si in MEMS devices operating in harsh environment. The development of 3C-SiC/Si/3C-SiC heterostructures on top of Si substrate can pave the road towards original and novel MEMS devices profiting from the properties of the 3C-SiC. However, such epitaxial system suffers from wide range of defects characterizing each layer. Thus, we first tried to improve the quality of each layer in this heterostructure. This was achieved relying on two levers; (i) the optimization of the growth parameters of each layer and (ii) the understanding of the nature of defects present in each layer. These two key points combined together allowed an in-depth understanding of the limit of improvement of the overall quality of this heterostructure. After the development of the complete heterostructure, the fabrication of 3C-SiC microstructures was performed. Furthermore, we presented an unprecedented method to form free-standing 3C-SiC membranes *in-situ* during its growth stage. This novel technique is expected to markedly simplify the fabrication process of suspended membranes by reducing the fabrication time and cost. Key words: cubic silicon carbide, silicon, heterostructures, chemical vapor deposition, epitaxy, defect engineering, suspended membranes.