ACS Applied Materials & Interfaces
2014
Vol. 6, Issue 10, p 7806-7815

Single Step Integration of ZnO Nano- and Microneedles in Si Trenches by Novel Flame Transport Approach: Whispering Gallery Modes and Photocatalytic Properties

Tim Reimer, Ingo Paulowicz, Robert Röder, Sören Kaps, Oleg Lupan, Steffen Chemnitz, Wolfgang Benecke, Carsten Ronning, Rainer Adelung, and Yogendra K. Mishra

https://doi.org/10.1021/am5010877

Abstract

Direct growth of quasi-one-dimensional nano- and microstructures in desired places of complex shaped substrates using simple growth methods is highly demanded aspect for various applications. In this work, we have demonstrated direct integration of ZnO nano- and microneedles into Si trenches by a novel flame transport synthesis approach in a single fabrication step. Growth of partially and fully covered or filled trenches in Si substrate with ZnO nano- and microneedles has been investigated and is discussed here. Detailed microstructural studies revealed the evolution of the ZnO nano- and microneedles as well as their firm adhesion to the wall in the Si trenches. Micro-photoluminescence measurements at different locations along the length of needles confirmed the good crystalline quality and also the presence of whispering gallery mode resonances on the top of needles due to their hexagonal shape. Faceted ZnO nano- and microstructures are also very important candidates with regard to photocatalytic activity. First, photocatalytic measurements from the grown ZnO nano- and microneedles have shown strong degradation of methylene blue, which demonstrate that these structures can be of significant interest for photocatalysis and self-cleaning chromatography columns.