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Integration of Metal and Metal Oxide Nanowires Directly on Chip by Top-Down Technology and Their Electrical Characteristics

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Abstract

In this work we present the fabrication of metal and metal oxide nanowires directly on chip by a new top-down technique based on thin film fracture (TFF) approach. Developed procedure works in a simple principle of constructive-destruction and cracks/fractures formation on a pre-patterned photoresist film on silicon chip. The metal and metal oxide nanowires were grown directly on the pre-patterned chip. A detailed overview about the formation of different types of fractures has been depicted. Nanowire fabrication by TFF approach involves only two steps, i.e., fracturing a lithographically patterned photoresist followed by physical vapor deposition process. With this approach, nanowires from desired inorganic materials (metals, metal-oxides or mixed oxides etc.) can be easily synthesized in a controlled manner. Nanowires from Au, Cu, Ti and ZnO with different thicknesses have been prepared on Si substrates and characterized. The morphological evolutions of the fabricated nanowires have been investigated by atomic force microscopy. Since these nanowires are directly integrated on the chips between two gold electrical contacts, electrical characteristics of device structures have been performed and discussed. A photo-detector was designed based on such a simple technique by nanobridging individual ZnO nanowire into electrically accessible device structures. Obtained results are very important for further development of nanoelectronics based on ZnO nanowires-bridged devices integrated on chip in a controlled manner and cost-effective procedure due to its unique potential for integrating with silicon based technology.