Impact of nanosecond pulse Ga ion beams on single crystal surfaces and growth of nanostructures

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Recent research into the fabrication of photonic devices has focused on bottom-up approaches toward producing arrays of one dimensional (1D) nanostructures. Systems of III-V/II-VI materials, particularly GaN and ZnO are ideal candidates for the fabrication of such devices and are being utilized separately or as 1D heterojunctions, however, many questions remain scientifically and from an engineering point of view in terms of their nanostructured device architecture, morphology control, defect propagation and device breakdown. To address these questions, we are developing model nanosystems and methods to controllably induce defects and trace their impact on nanodevice function. Ga FIB instrumentation enables the control necessary for such model systems through tunability of the location and number of ions we can introduce, to as few as 1 ion per beam pulse per location with nanometer resolution. Using this methodology, our initial results of nanosecond ion pulses into single crystal GaN point toward a dependence on the degree of ion beam overlap and dose (or fluence) on the breakdown of electrical properties in the heterojunction region as well as the ability of ZnO nanowires to grow over regions disrupted by the ion beam. Further studies will expand this investigation toward understanding the performance of these devices under such circumstances.