Molecular Beam Epitaxy of III-Nitride Nanowires on Amorphous and Nanocrystalline Metals

Brelon J. May[1], Elline C. Hettiaratchy[1], Roberto C. Myers[1,2]

[1]Materials Science and Engineering, The Ohio State University, Columbus, OH
[2]Electrical and Computer Engineering, The Ohio State University, Columbus, OH

The high surface area to volume ratio of nanowires allows them to have a larger degree of strain relaxation relative to their thin film counterparts. This enables high quality material to be grown on a variety of materials, including polycrystalline metal foils [1]. However, inhomogeneity associated with self-assembled growth reduces device efficiency. The polycrystalline nature of typical metal foils adds additional nonuniformities related to the metallic microstructure, e.g. grain boundaries and orientations (Fig. 1(a)). One possible solution is to tailor the substrate microstructure to have grain sizes of the same order as the nanowires, such that flux shadowing would limit the impact of microstructure variation. A more ideal option is to eliminate the microstructure altogether through the use of a metallic glass substrate i.e. amorphous metal. Here we demonstrate the growth of III-Nitride nanowires on Pt thin films as well as on amorphous metal foils. SEM measurements show that growth on amorphous foils enhances not only the uniformity of the density but also results in a higher degree of vertical nanowire alignment (Fig. 1(b)). The variations in optical and structural properties of the nanowire ensembles will be discussed in relation to the substrate microstructure.

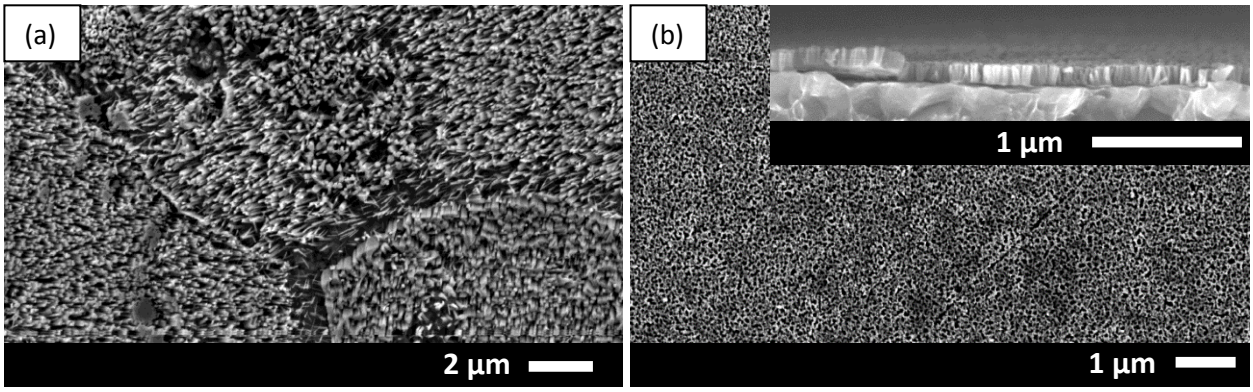

Figure 1: Plan view SEM images of GaN nanowires on (a) a Ti foil and (b) an amorphous foil, inset shows cross section view of the wires on the amorphous foil.

[1] B. J. May, ATM G. Sarwar, and R. C. Myers, Appl. Phys. Lett. 108, 141103 (2016)