

**2012 Materials Research Society Fall Meeting  
November 25 – November 30, 2012,  
Boston Massachusetts USA  
E15: Thin Film Solar Cells III  
Chair: Ramesh Dhere  
Thursday AM, November 29, 2012  
Hynes, Level 3, Ballroom A**

**8:30 AM - E15.01**

**Effects of Geometry on Thin Film Photovoltaics**

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Charge carrier transport varies as a function of the geometrical configuration of the photovoltaic junction. Geometrical configurations of photovoltaic architectures can be broken down into conventional planar junctions, for which carrier dynamics are fundamentally one dimensional, and unconventional non-planar junctions, for which one of the fundamental aims is to separate optical and electronic length scales. To date, planar solar cell architectures still hold all efficiency records over non-planar counterparts. Moreover, while intellectually pleasing, it is not a trivial task to decouple electronic and photonic pathways, and a detailed understanding of the physics governing transport in non-planar photovoltaic junctions is still lacking. By aptly detailing the device physics for varying geometrical configurations of a photovoltaic junction, the geometry of the junction can be studied to ascertain which configurations maximally improve cell efficiency. Because of their often severely limited minority carrier recombination lifetimes, non-crystalline materials potentially benefit from non-planar photovoltaic architectures more so than solar cells fabricated from monocrystalline materials. Here, total current of the photovoltaic junction is derived as a function of its geometrical configuration and analytical expressions for device transport and efficiency are numerically calculated for an array of vertically aligned, nanocoaxial, a-Si solar cells. In addition to efficiency comparisons between coaxial and planar photovoltaic junctions, physical differences in the generation and recombination rates, based purely on geometrical considerations, are analyzed for non-planar architectures.