It took 60 years for carbon fiber to go from invention to application in commercial aerospace. This timeline was driven largely by the need for empirical testing to manage uncertainties in the composite material system state, which drives the performance of composite materials. Nondestructive Evaluation (NDE) technologies for characterizing defects and damage in fiber-reinforced composites have come a long way during this timeframe. This talk begins by quickly summarizing two paradigm shifts in how NDE data is acquired and processed to enable rapid characterization of composite materials to support manufacturing and operational decision-making in large-scale applications. First, pulse thermography using infrared imaging is discussed as a means of overcoming the challenge of in-line NDE to support rapid manufacturing environments. Next, nonlinear spectroscopy is discussed as a means of overcoming the challenge of wide area NDE of large, complex structures. The talk focuses on a technology that could be the next paradigm shift in NDE for composites, one that uses advances in nanotechnology – specifically nanocrystal LED (light emitting diodes) – to realize direct sensing of composite damage across multiple time and length scales. CdSe nanocrystals are embedded in optically clear epoxy reinforced through the use of silicon particles and the overall light emission spectrum for samples with varying %-weights of CdSe nanocrystals are evaluated using an integrating light sphere. After establishing a baseline emission for CdSe nanocrystals in an undamaged state, preliminary test results for characterizing damage in the specimens are discussed.