Optofluidics is a recently developed field of research focused on the integration of optical devices with microfluidics. This mutually beneficial fusion has been critical to new microscale technologies such as fluidically adaptable optics and low-mass detection optical biosensors. By exploiting the fundamental interactions of light with matter, it becomes possible to directly interface and manipulate objects within microfluidic chips using light. Here I will show how nanophotonic optical structures provide a means of generating and controlling high-intensity optical fields which can then be used to direct particles in a fluid. The integration of nanophotonics with microfluidics results in a new paradigm of optically driven transport that can operate at nanoscale dimensions. A key result of this research has been the demonstration of the all-optical trapping of single λ-DNA biomolecules. This talk will also discuss methods for enabling advanced particle control using resonant optical structures. The advancements made here are a first step towards bridging the gap between microfluidics and nanophotonics.