Accurate visualization of structures and events at subcellular level is one of the major challenges of current neuroscience. Optical methods based on fluorescence imaging were optimized to record and control neural activity, thus presenting a powerful approach complementary to historically dominant electrophysiological techniques. The employment of two-photon excitation enabled *in vivo* imaging of neurons up to 1 mm from the sample surface without causing significant photodamage. The application of methods of molecular biology has yielded protein-based genetically targetable indicators of neural activity, possessing performance comparable to the traditional organic dyes. Moreover, heterologous expression of microbial opsins proved capable of light-induced neural excitation or silencing in a single-component manner. The combination of these optogenetic tools offers two-way control over neuronal populations with single cell resolution. If coupled with calcium or voltage fluorescent indicators and transgenic animal models, such systems represent a non-invasive, all-optical tool for simultaneous control and imaging of specific neuronal subtypes. Its application supported by electrical recordings may finally provide the data necessary for the uncovering of fundamental principles of neural functioning.