Protein reconstitution methods for visualizing biomolecular function in living cells

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A current focus of biological research is to quantify and image cellular processes in living subjects. To detect such cellular processes, genetically-encoded reporters have been extensively used. The most common reporters are firefly luciferase, *renilla* luciferase, green fluorescent protein (GFP) and its variants with various spectral properties. Herein, novel design of split GFP and split luciferase will be described; the principle is based on reconstitution of the split-reporter fragments when they are brought together into close proximity. To demonstrate usefulness of the split-reporter reconstitution, we have used the reporters for developing a genetic method to identify mitochondrial proteins and their localization, and noninvasively image a target protein transported into the nucleus in living mice. In this symposium, I will describe methods of imaging endogenous mRNA in single living cells and protease activities in living animals. These reporter proteins are generally applicable for visualization of complex cellular processes in living cells and animals.