[Invited Speech/ CBRC2012:The Impact of Next Generation Sequencers]

Biogenesis of mitochondria: Import, insertion and assembly of inner and outer membrane proteins

Nils Wiedemann
Stockholm University

Mitochondria are the powerhouses of our cells, catalyzing the terminal oxidation of our food to carbon dioxide and the reduction of molecular oxygen to water. In turn the harvested energy derived from this process is exported from mitochondria in form of adenosine triphosphate to power the life of our cells. Mitochondria contain about 1000 proteins, which catalyze such essential reactions in our bodies. However, more than 98% of all mitochondrial proteins are encoded within the nucleus, synthesized in the cytosol and have to be imported into mitochondria.
Classical mitochondrial precursor proteins comprise an amino terminal amphipathic presequence, which is required and sufficient to import an unfolded precursor protein. Receptor proteins recognize the mitochondrial presequence and initiate the import through the translocase of the outer membrane (TOM) and the presequence translocase of the inner membrane (TIM23) into the innermost matrix subcompartment.
In contrast, mitochondrial membrane protein biogenesis is a very complex process because mitochondria have two membranes and harbor membrane proteins with alpha-helical and beta-barrel conformation. Membrane proteins often have internal targeting signals, which are recognized by membrane protein-specific insertases like the carrier translocase of the inner membrane (TIM22) and the sorting and assembly machinery of the outer membrane (SAM).