Study of regulation of kinesin using photo controllable kinesin auto-inhibitory domain

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The field of biomolecular motors (BMMs) is an ever-advancing area where the development of active matter is being pursued. It will help to realize a variety of applications in robotics as actuators, smart materials, and in life sciences where their biocompatibility and biodegradability can give them the upper hand. There have been different approaches to achieve this using NEMS/MEMS, artificial molecular motors, and biomolecular motors. Here, biomolecular motors have immense potential due to their facile synthesis, harmony with medical devices, easier upscaling, and good energy conversion. BMMs being versatile, can be manipulated using a variety of stimuli, however, use of light as the controlling agent has proven to be advantageous due to its better spatio-temporal resolution, easy handling, and versatility. Previous initiatives in this area fail to have feasible motor activity time.

Concurrently, our lab was able to construct a hierarchical organization of BMMs (kinesin-microtubule model) which are printable with UV light as the stimulus and prepared artificial muscle that can actuate millimeter scaled microrobots. These BMMs, however, are not reversible and cannot relax to their original state. For reversibility, our lab devised an auto-inhibitory kinesin construct KI-K465-m13 where the KI domain can bind with the kinesin head. This transforms kinesin into its inhibited state where microtubules cannot bind with it. This aspect will be further studied by developing fusion proteins containing a light-sensitive domain. The resultant light sensitive kinesin (LOV-KI-K465-m13) fusion protein changes its conformation in response to blue light. Here the kinesin will be in the inhibited state in presence of light and show no contraction, while in the absence of light it will be in the active state and show contraction (refer Fig 1). Therefore, this model proposes to grant reversibility to BMMs in the form of photo-controllable kinesin artificial muscle that will show macro-level-controlled movement on light exposure.

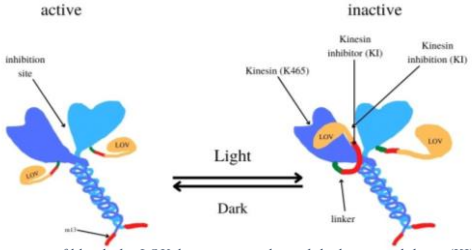

Figure 1. Regulation of LOV-KI-K465-m13: In presence of blue light, LOV domain unwinds, and the kinesin inhibitor (KI) will bind with kinesin head thus inhibiting it