What determines the motion behavior of enzyme micromotors?

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Bio-catalytic micro- and nanomotors self-propel by the enzymatic conversion of substrates into products.[1] Despite the promising advances in the field, the fundamental aspects underlying enzyme-powered self-propulsion have rarely been studied, and need to be addressed to make implementations more feasible. We focus our research on the study of the intrinsic and extrinsic parameters governing active motion of enzymatic micromotors.[3]

Herein, we explore the powering capacity of urease, acetylcholinesterase, glucose oxidase and aldolase to propel silica-based micromotors, and assess the relevance of the turnover number and conformational dynamics on the self-propulsion.[4] Results show that the motion behavior is strongly dependent on the enzyme type. Further, the effect of media composition on motion was evaluated for urease micromotors. The presence of ionic species reduced self-propulsion pointing towards ion-dependent mechanisms of motion.[5] We partially overcome this limitation by coating the micromotors with PEG.

We conclude that enzymatic motors are strongly dependent on the intrinsic conformational changes and catalytic rate of catalysis, and extrinsic ionic media composition.

References

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Figures

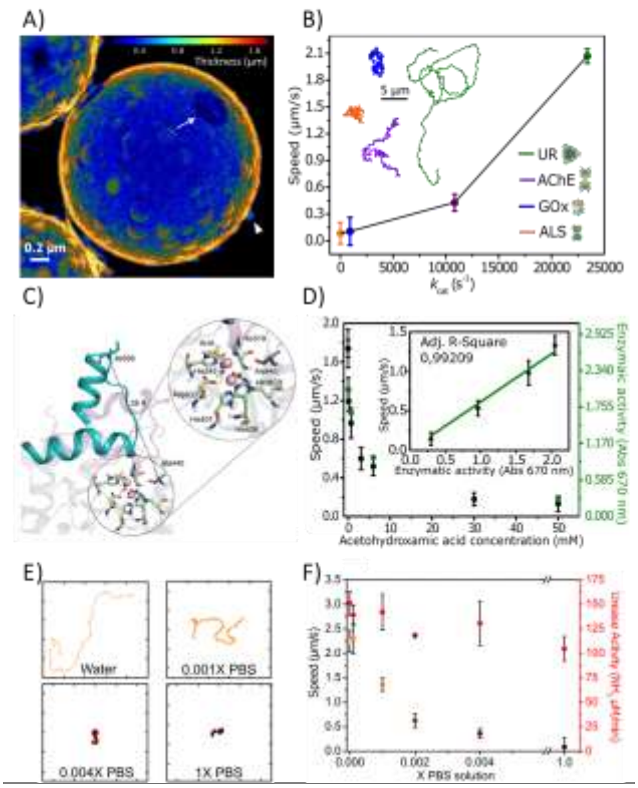

Figure 1: (A) TEM micrograph of microcapsule (colored thickness). Detection of hole (arrows) and silica bulks (arrowheads). (B) Speed vs. turnover number (k_{cat}) of enzymatic micromotors. Inset: Trajectories of the enzymatic micromotors. (C) Molecular dynamic simulation of urease with inhibitor stabilizing the strucutre in wide-open state (teal). (D) Speed and activity of urease micromotors vs inhibitor concentration. Inset: linear correlation of speed and enzymatic activity. (E) Trajectories of urease micromotors vs PBS concentration. (F) Speed and activity of urease micromotors vs PBS concentration.