Some of the most efficient catalytic designs are found in nature. Cells contain multi-step metabolic pathways where series of biochemical reactions catalyzed by enzymes take place. Substrate channeling is maximized by the architecture and scaffolding of biological molecules. The scaffolding of biological molecules has been used to design multi-enzyme structures with catalytic properties. This idea can be enhanced to position not only enzymes, but other types of catalysts. The oxidation of fructose to carbon dioxide is a multi-step process that utilizes several different types of catalysts. Biomolecular scaffolds mimicking those found in nature and incorporating the different types of catalysts, such as nanoparticles or enzymes, of the catalyst cascade could be constructed.

Steady-state two-dimensional flow model of intermediate transport between active sites.

- Model dimensionless \( \varphi = \frac{kd}{D} \)
- Can look at flux, yield, and flux control coefficients (FCCs)

Mainly used in purely kinetic systems

\[
C_i = \frac{D_f}{j} \frac{E_i}{dE} \sum C_i = 1 \quad e_i = \frac{S_i}{dS} \sum C_i e \quad N_i = \frac{2 \pi D_f}{R \theta} C_i \varphi - D_i \varphi C_i + C_i \nu
\]

\[
C_{Di} = \frac{D_i}{j} \frac{dJ}{dD_i}
\]

We have developed a continuum model for intermediate transport and shown how the efficiency of this model is changed with certain parameters. Future work includes developing a better understanding of how parameters effect the model \((K_a, \varphi)\). The overall goal is to eventually expand this model to include many to all the reaction steps of the cascade.

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