At the Frontier of Mobile Renewable Energy from Dynamic Catalyst Surface Resonance

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Abstract. The emergence of competitive renewable energy from solar and wind heightens the importance of moving energy from the place of origin to the places where people live and work. Chemically capturing energy as compressed hydrogen or energy liquids including hydrocarbons and ammonia remains the leading method of energy storage based on density and fungibility, but the catalytic technology necessary for transformation of electricity into chemicals in small, distributed energy systems is the key challenge for implementation. In this work[1], the general approach of dynamic catalyst operation is described as oscillatory binding energy of sorbates on active sites as a method to dramatically accelerate the rate of catalytic reaction. Surface oscillations in sinusoidal and square waveforms of transient binding energy are imposed on catalyst surfaces with varying amplitude and frequency to identify the resonance conditions leading to 10,000x enhancement in overall reaction rate. The results are presented in the context of catalyst-reaction behavior and with regard to implementation in industrial reactor technologies necessary for moving and storing renewable energy.

References

[1] A. Ardagh, O. Abdelrahman, P.J. Dauenhauer, "Principles of Dynamic Heterogeneous Catalysis: Surface Resonance and Turnover Frequency Response" *ChemRxiv Preprint*, 2019. doi.org/10.26434/chemrxiv.7790009.v1