Electronic Supplementary Material (ESI) for Soft Matter.

Electronic Supplementary Information

Bobbing chemical garden tubes: oscillatory self-motion from buoyancy and catalytic gas production

Qingpu Wang‡ and Oliver Steinbock*

Department of Chemistry and Biochemistry, Florida State University

Tallahassee, FL 32306-4390, USA

* E-mail: osteinbock@fsu.edu

‡ Present address: Energy and Environment Directorate, Pacific Northwest National Laboratory, Seattle, WA 98109, USA

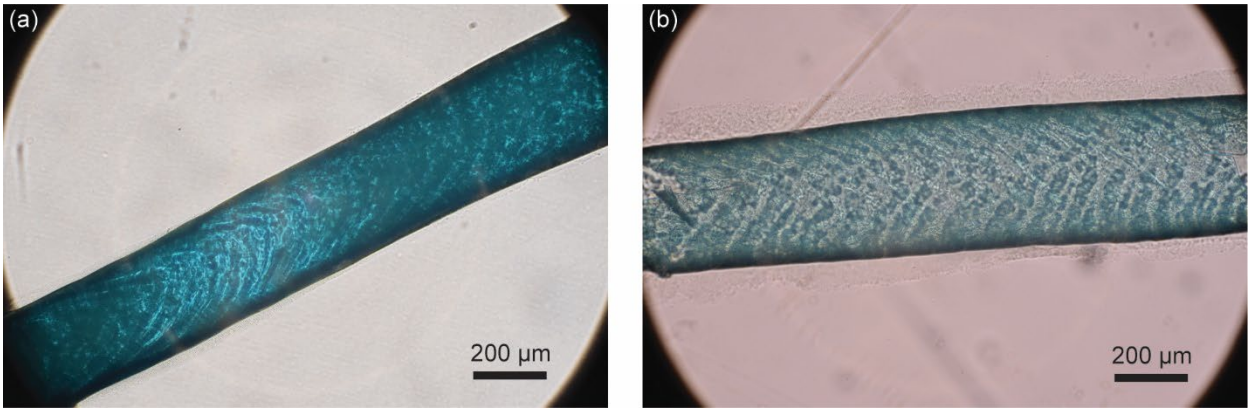

Fig. S1 Optical micrographs of silica-$Cu(OH)_2$ precipitate tubes. These samples are representative of the tubes used in our study (prior to H_2O_2 exposure). The tube walls show spatially periodic stripe patterns that might indicate minor variations in the local surface roughness and (as judged from the color variations) variations in the silicon-to-copper ratio. We note that earlier studies reported similar stripe patterns for chemical garden tubes prepared under similar conditions.[S1,S2] These studies showed that the stripe patterns are also discernable from SEM images.

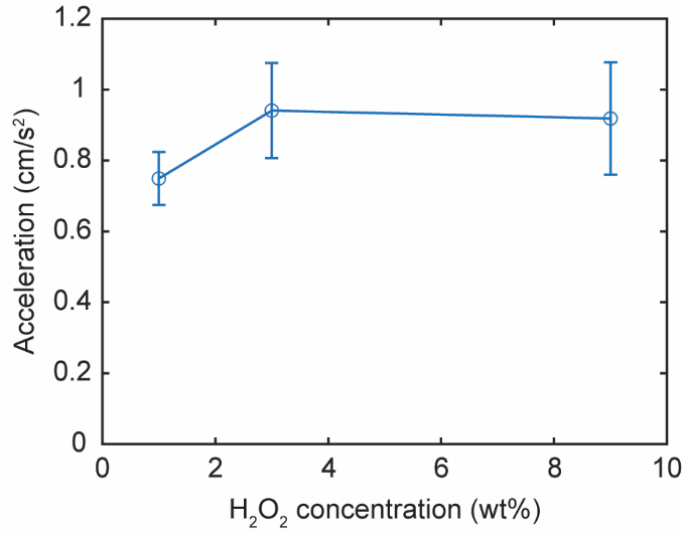

Fig. S2 Tube acceleration versus the concentration of H_2O_2. The error bars indicate standard deviations from four measurements. These results possibly suggest a mild concentration-dependent acceleration (and hence the rate constant *k*) during the ascent phase.

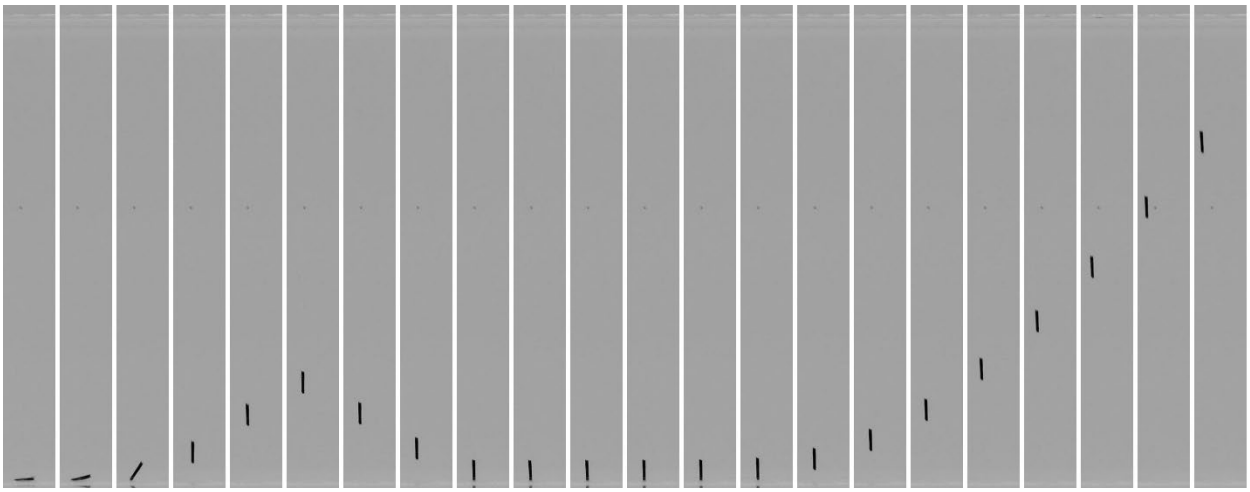

Fig. S3 Image sequence showing the motion of a tube at 0.5 s intervals. The time increases from left to right. In this example, the ascending motion aborted (sixth frame) due to the release of the buoyancy-providing gas bubble. Field of view: 55 × 6 mm^2. Concentration of H_2O_2: 1 %.

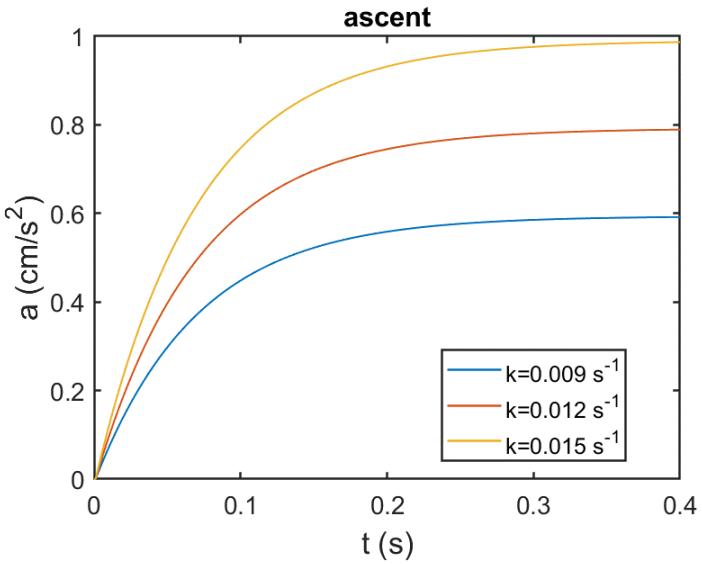

Fig. S4 Calculated acceleration of ascending tubes for three rate constants *k*. The figure complements the data shown in Fig. 6. Notice that the terminal velocities are reached in about 0.3 s.

Movie S1. Real-time movie showing the bobbing motion of a chemical garden tube in a 1% H_2O_2 solution. Field of view: 10 × 60 mm^2.

References

S1. See Fig. 8a in: J. J. Pagano, S. Thouvenel-Romans and O. Steinbock, "Compositional Analysis of Copper-silica Precipitation Tubes", *Phys. Chem. Chem. Phys.* **9**, 110-118, 2007.

S2. See Fig. 8 in: S. Thouvenel-Romans, J. J. Pagano and O. Steinbock, "Bubble Guidance of Tubular Growth in Reaction–precipitation Systems", *Phys. Chem. Chem. Phys.* **7**, 2610-2615, 2005.