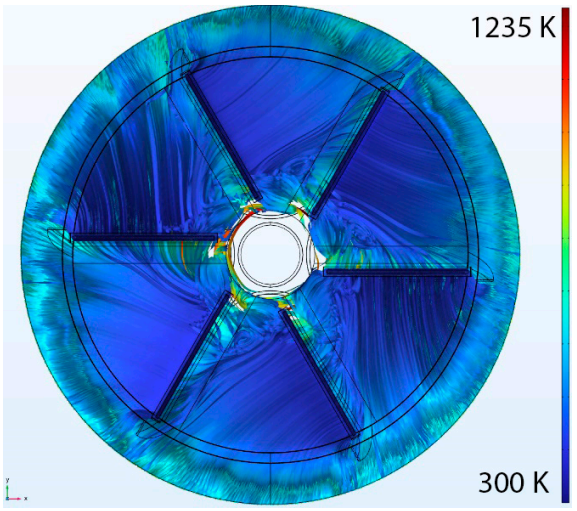
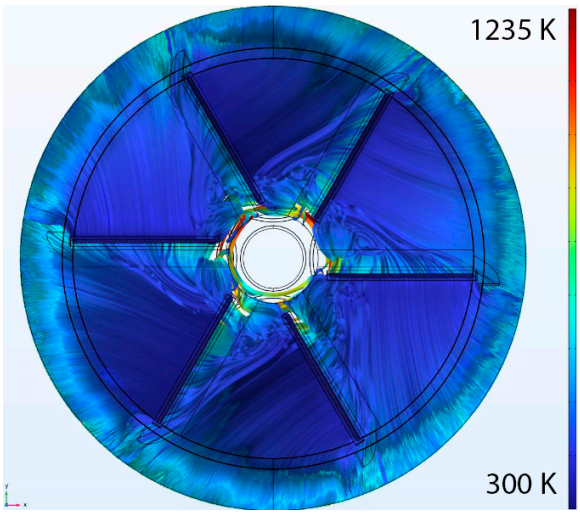
This supplementary document presents additional plots of velocity streamlines for nitrogen, hydrogen, and ammonia at the pressure of 10 atm and beyond. Similar to the main manuscript, 10,000 streamlines were considered in each plot while the legend bar shows the maximum and minimum temperature values. The numerical results, including the temperature color-coded velocity streamlines, for nitrogen, hydrogen, and ammonia are provided in sections S1, S2, and S3, respectively.

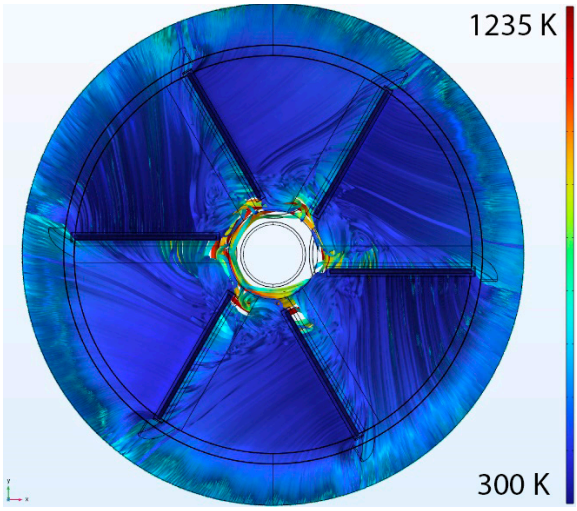
**S1 Fluid flow study, nitrogen**



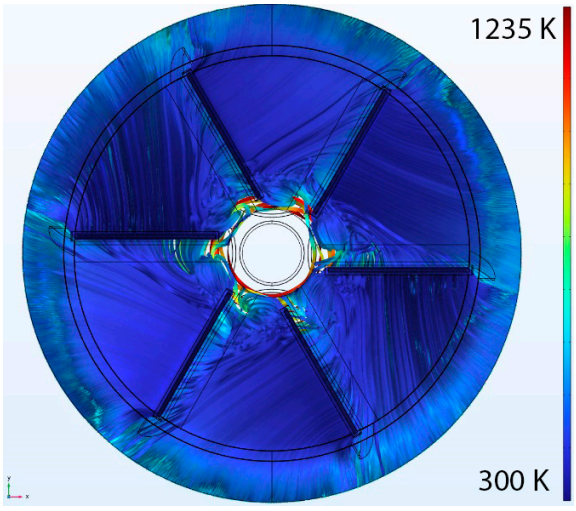

(a) Inlet velocity of 0.5 m/s for $N_2$, 10 atm, 100 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 10 atm, 100 rpm

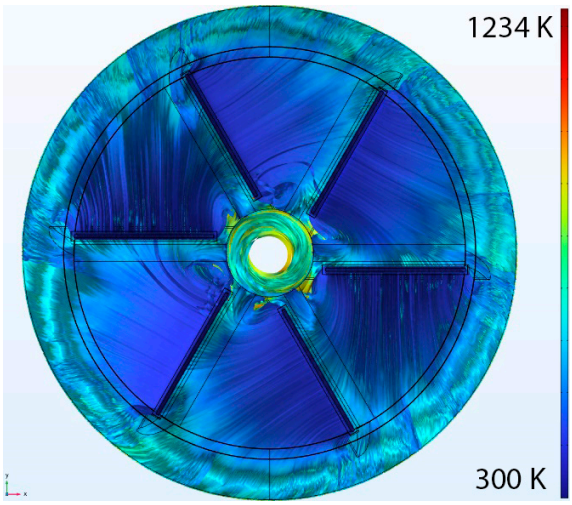



(c) Inlet velocity of 0.7 m/s for $N_2$, 10 atm, 100 rpm

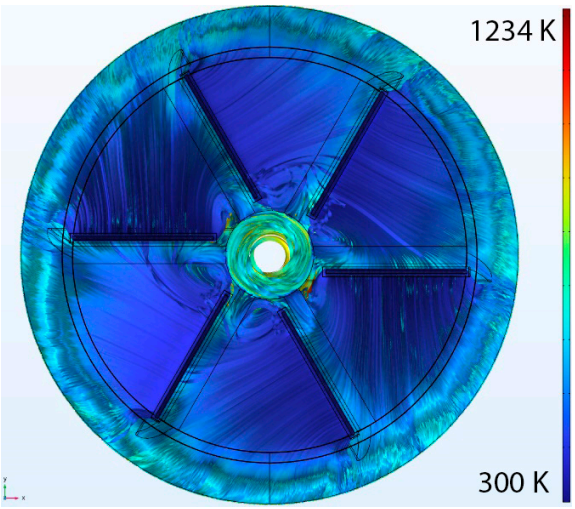



(d) Inlet velocity of 0.8 m/s for $N_2$, 10 atm, 100 rpm

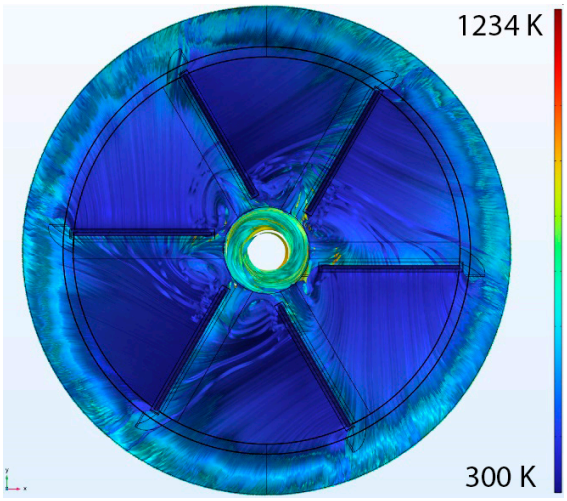
Figure S1. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 10 atm pressure. The disk rotates at 100 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1235 K (red).



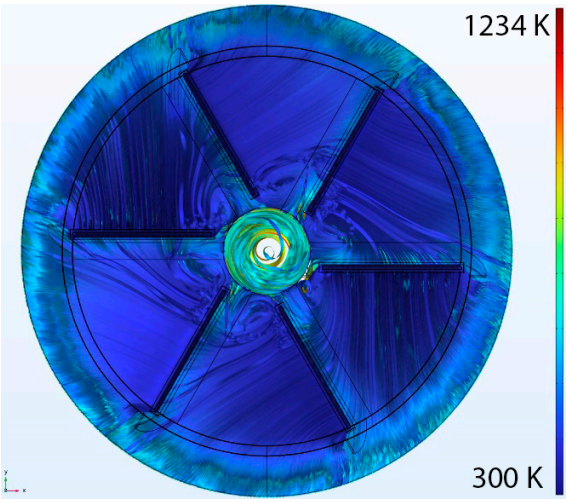

(a) Inlet velocity of 0.5 m/s for $N_2$, 10 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 10 atm, 200 rpm

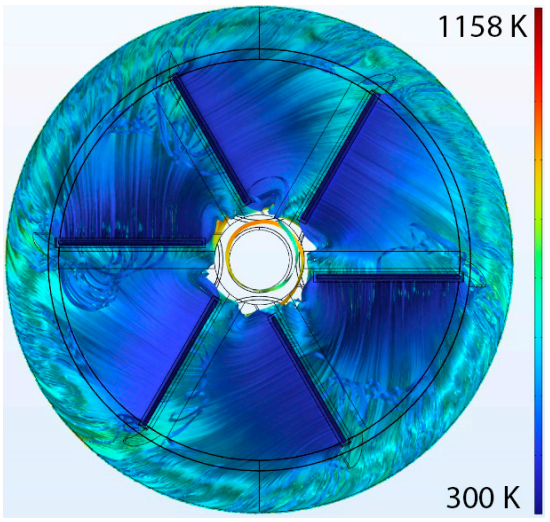



(c) Inlet velocity of 0.7 m/s for $N_2$, 10 atm, 200 rpm

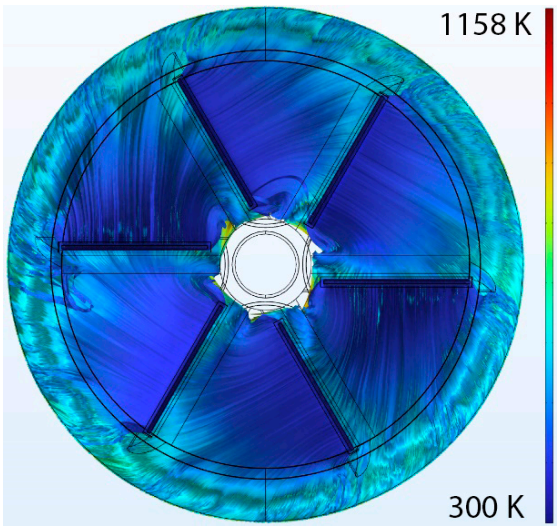



(d) Inlet velocity of 0.8 m/s for $N_2$, 10 atm, 200 rpm

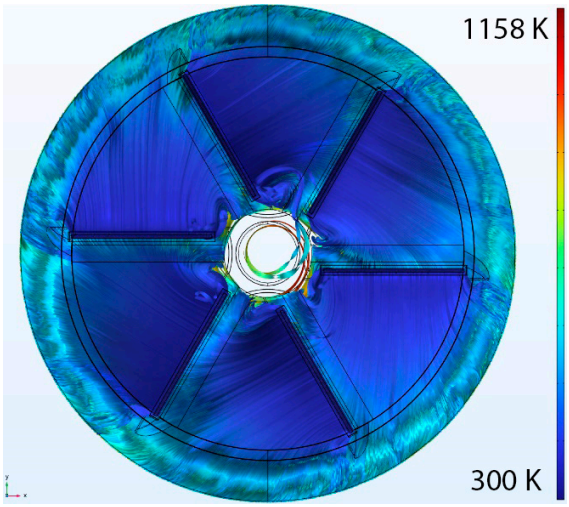
Figure S2. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 10 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1234 K (red).



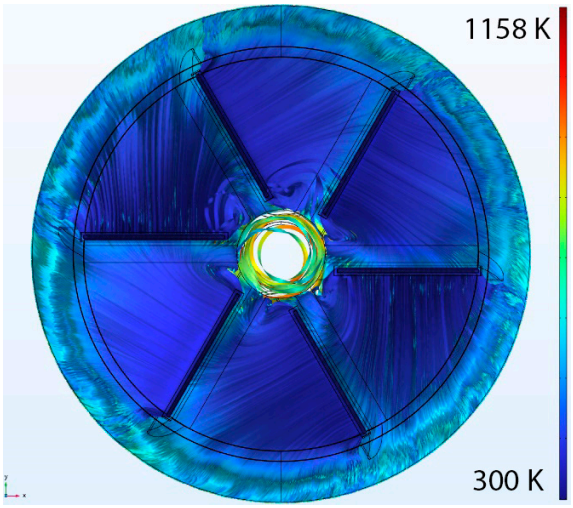

(a) Inlet velocity of 0.5 m/s for $N_2$, 10 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 10 atm, 300 rpm

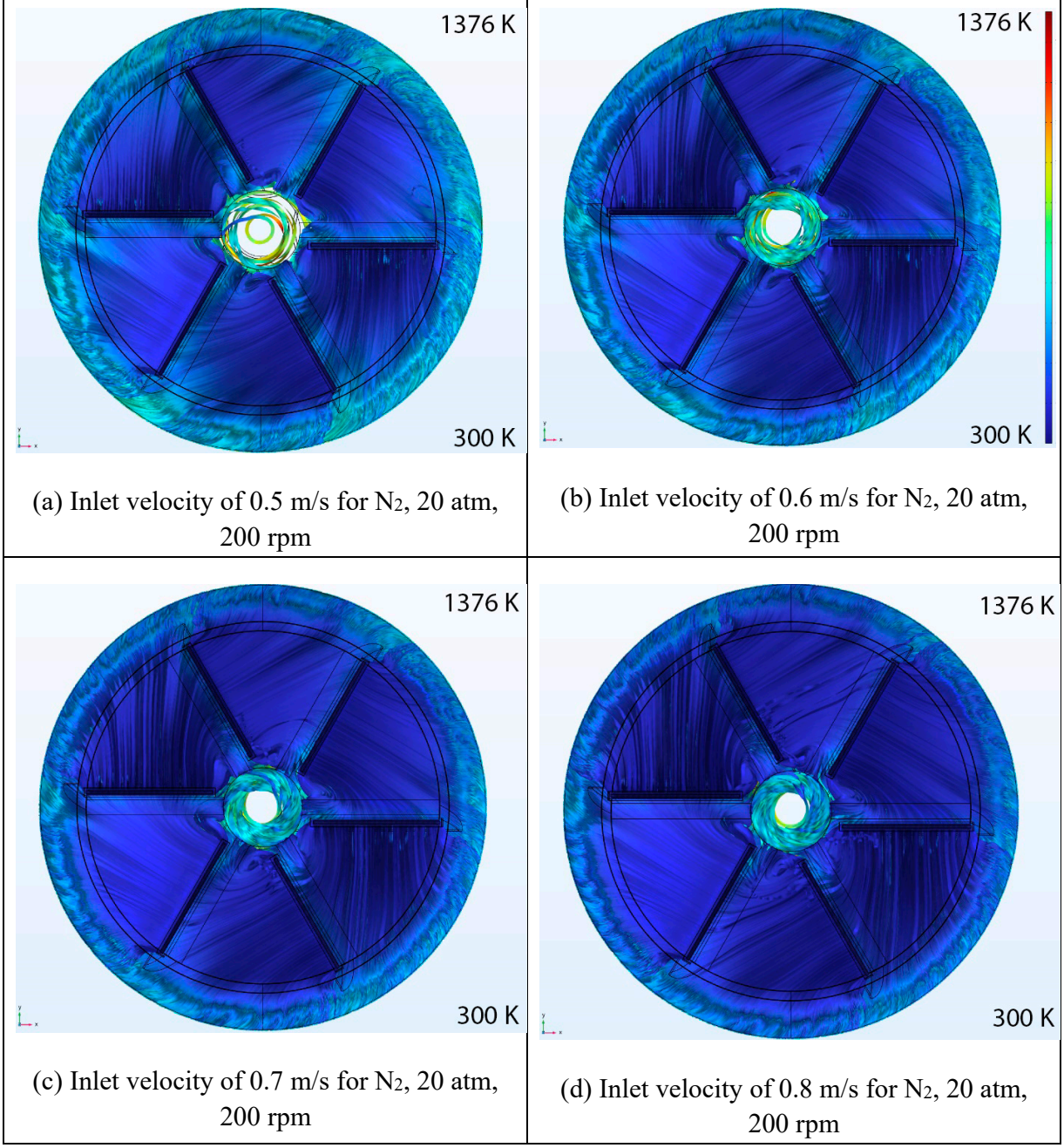



(c) Inlet velocity of 0.7 m/s for $N_2$, 10 atm, 300 rpm




(d) Inlet velocity of 0.8 m/s for $N_2$, 10 atm, 300 rpm

Figure S3. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 10 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1158 K (red).



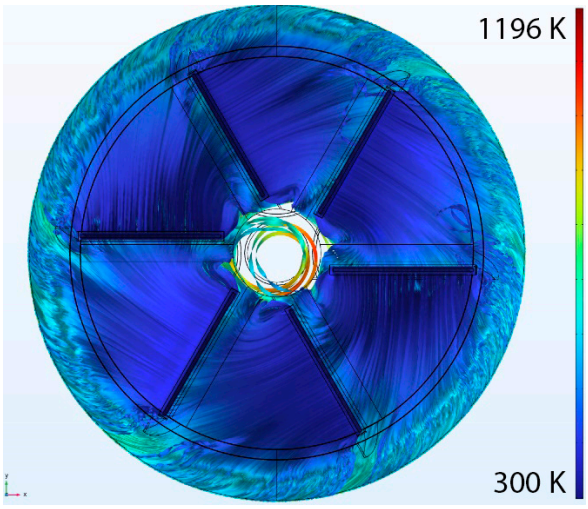

(a) Inlet velocity of 0.5 m/s for $N_2$, 20 atm, 200 rpm

(b) Inlet velocity of 0.6 m/s for $N_2$, 20 atm, 200 rpm

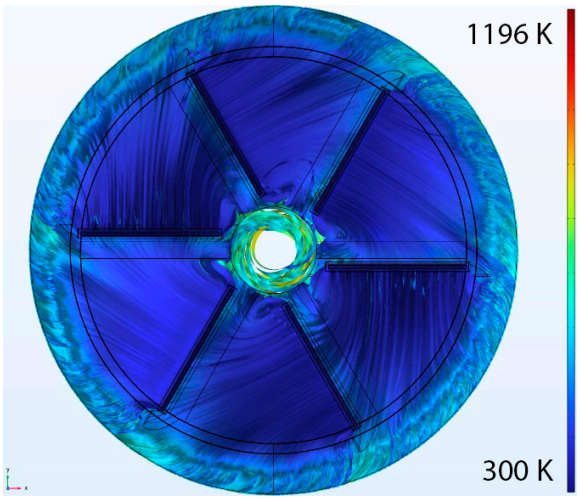
(c) Inlet velocity of 0.7 m/s for $N_2$, 20 atm, 200 rpm

(d) Inlet velocity of 0.8 m/s for $N_2$, 20 atm, 200 rpm

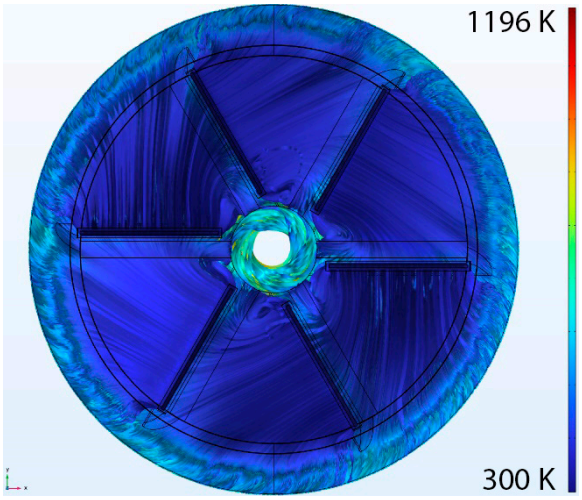
Figure S4. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 20 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1376 K (red).



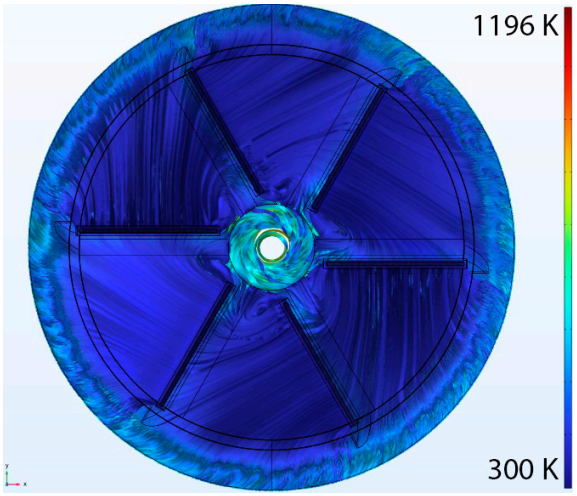

(a) Inlet velocity of 0.5 m/s for $N_2$, 20 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 20 atm, 300 rpm

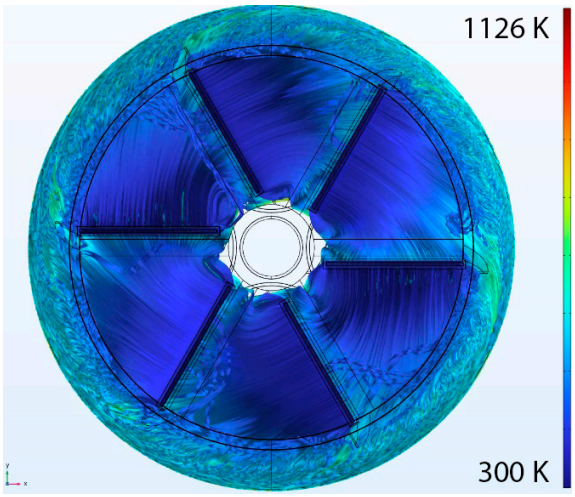



(c) Inlet velocity of 0.7 m/s for $N_2$, 20 atm, 300 rpm

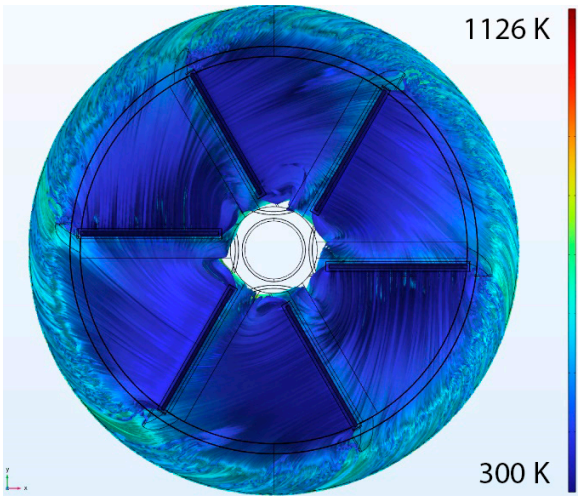



(d) Inlet velocity of 0.8 m/s for $N_2$, 20 atm, 300 rpm

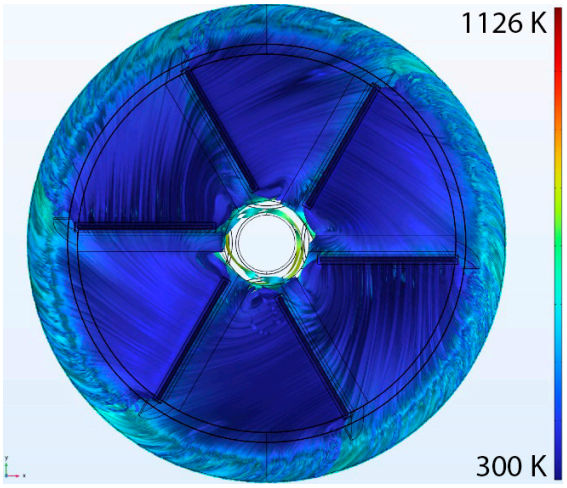
Figure S5. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 20 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1196 K (red).



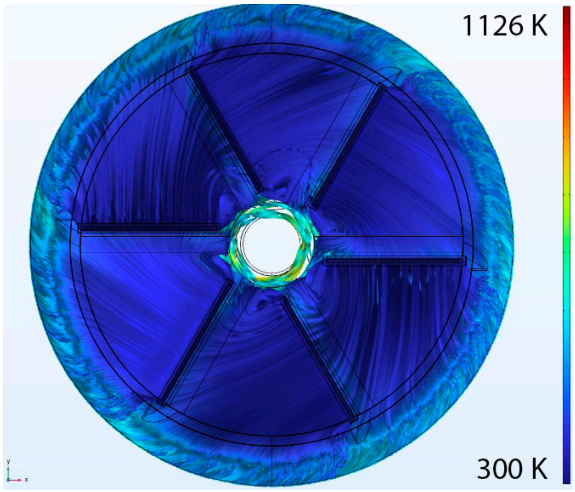

(a) Inlet velocity of 0.5 m/s for $N_2$, 20 atm, 400 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 20 atm, 400 rpm

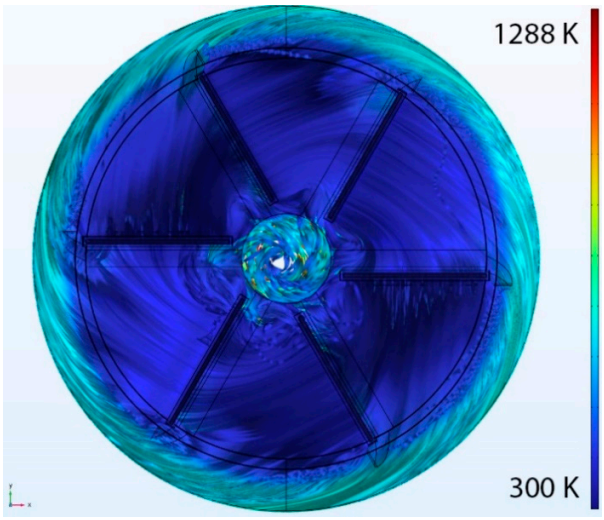



(c) Inlet velocity of 0.7 m/s for $N_2$, 20 atm, 400 rpm

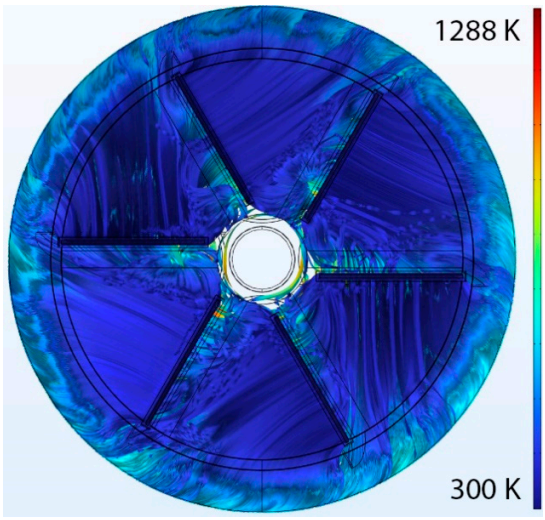



(d) Inlet velocity of 0.8 m/s for $N_2$, 20 atm, 400 rpm

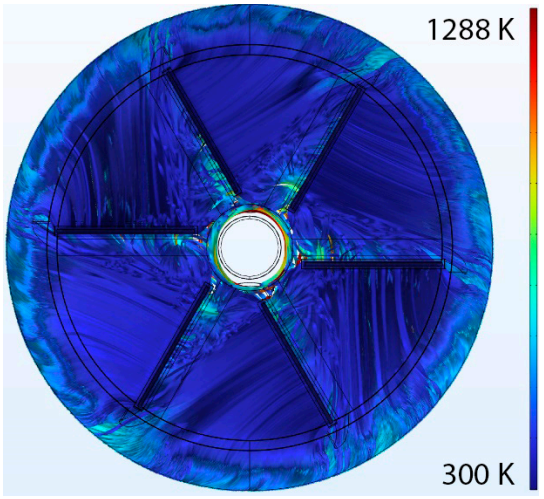
Figure S6. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 20 atm pressure. The disk rotates at 400 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1126 K (red).



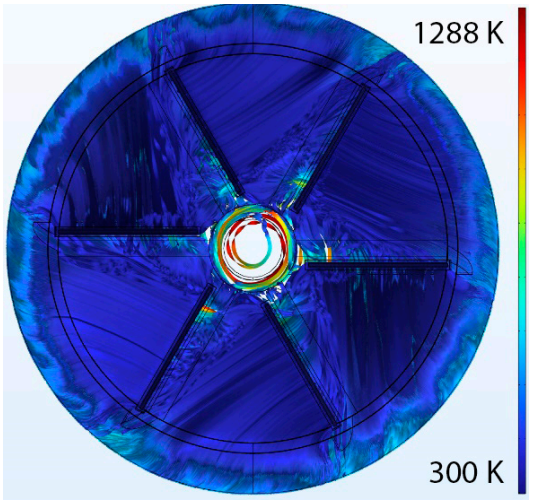

(a) Inlet velocity of 0.5 m/s for $N_2$, 30 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 30 atm, 200 rpm

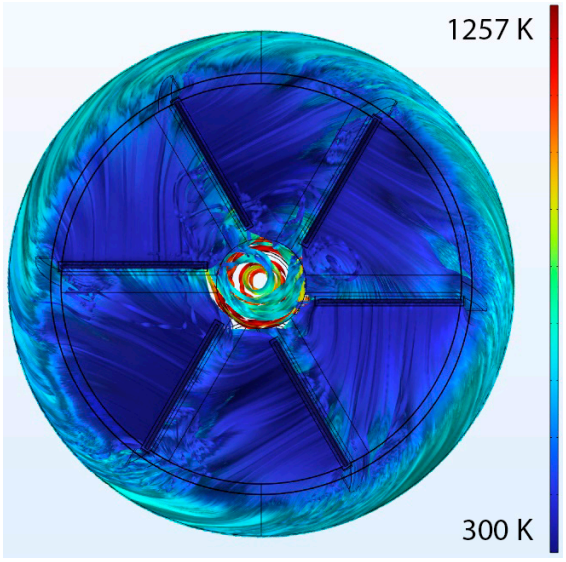



(c) Inlet velocity of 0.7 m/s for $N_2$, 30 atm, 200 rpm

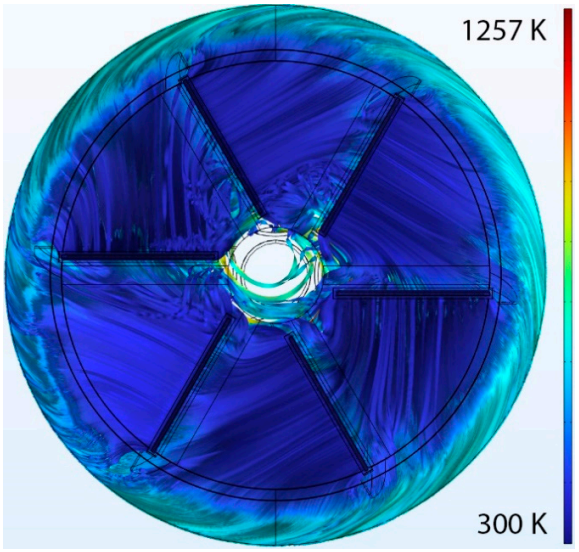



(d) Inlet velocity of 0.8 m/s for $N_2$, 30 atm, 200 rpm

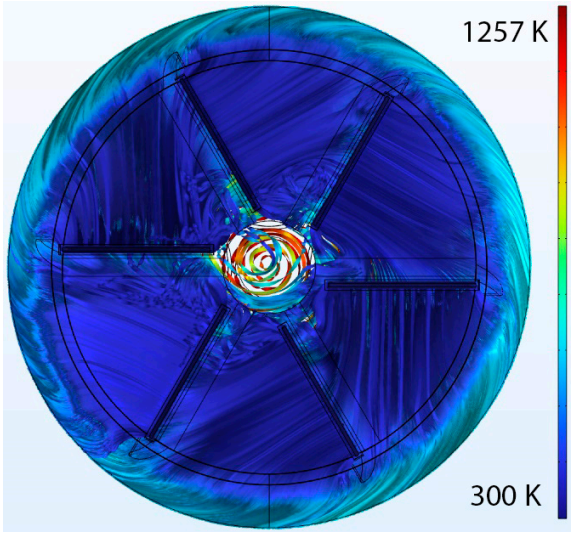
Figure S7. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 30 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1288 K (red).



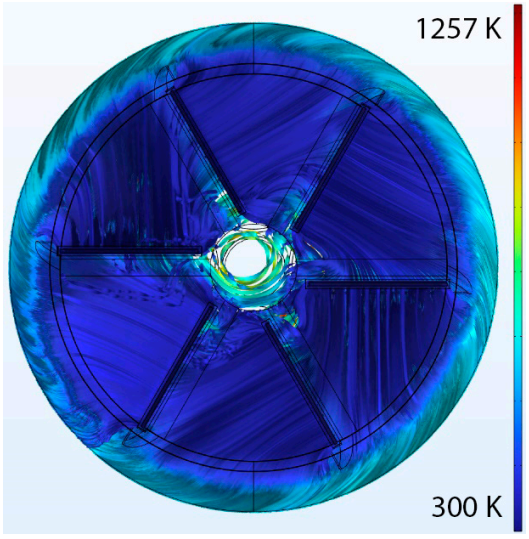

(a) Inlet velocity of 0.5 m/s for $N_2$, 30 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 30 atm, 300 rpm

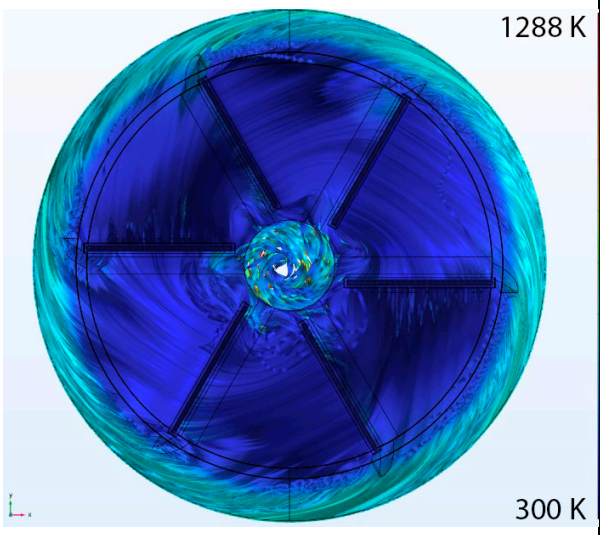



(c) Inlet velocity of 0.7 m/s for $N_2$, 30 atm, 300 rpm

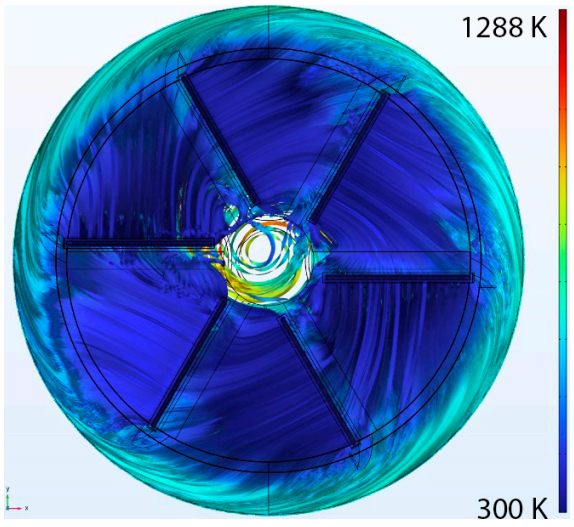



(d) Inlet velocity of 0.8 m/s for $N_2$, 30 atm, 300 rpm

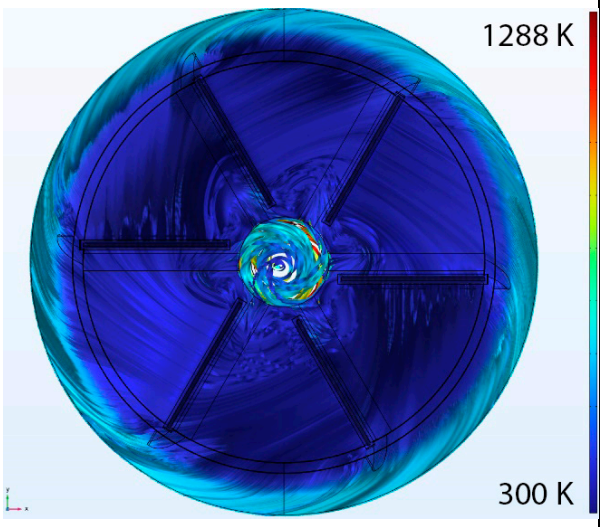
Figure S8. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 30 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1257 K (red).



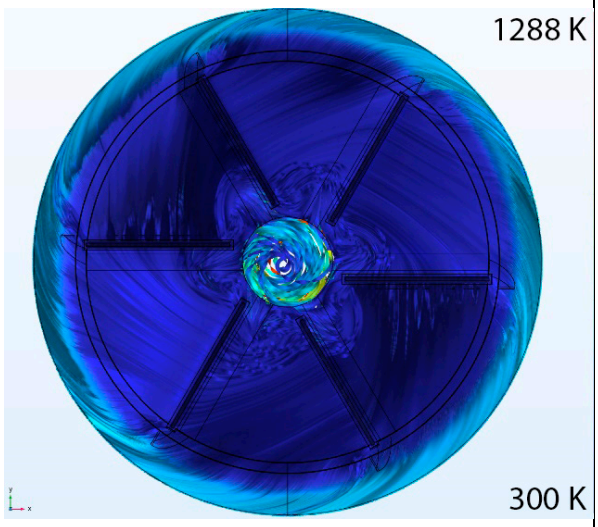

(a) Inlet velocity of 0.5 m/s for $N_2$, 30 atm, 400 rpm




(b) Inlet velocity of 0.6 m/s for $N_2$, 30 atm, 400 rpm



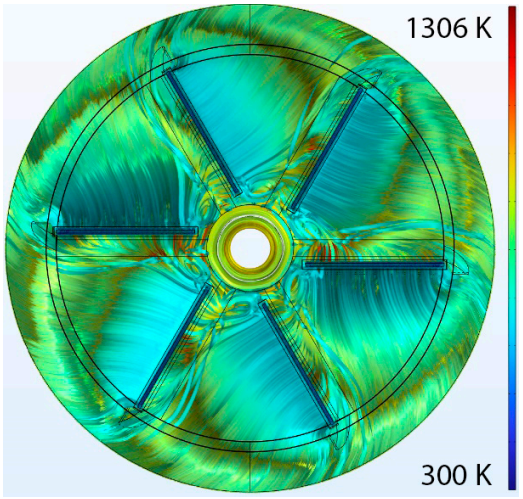

(c) Inlet velocity of 0.7 m/s for $N_2$, 30 atm, 400 rpm



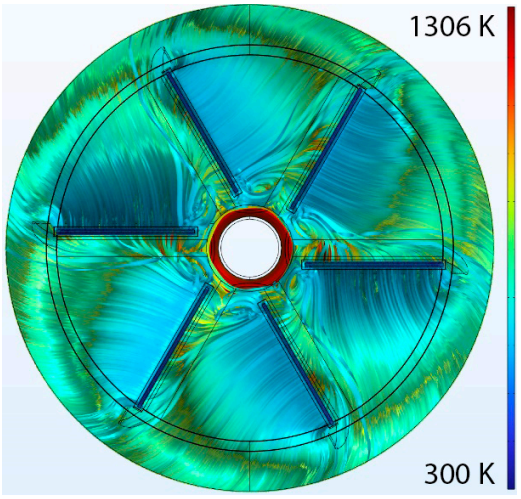

(d) Inlet velocity of 0.8 m/s for $N_2$, 30 atm, 400 rpm

Figure S9. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $N_2$ at 30 atm pressure. The disk rotates at 400 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1288 K (red).

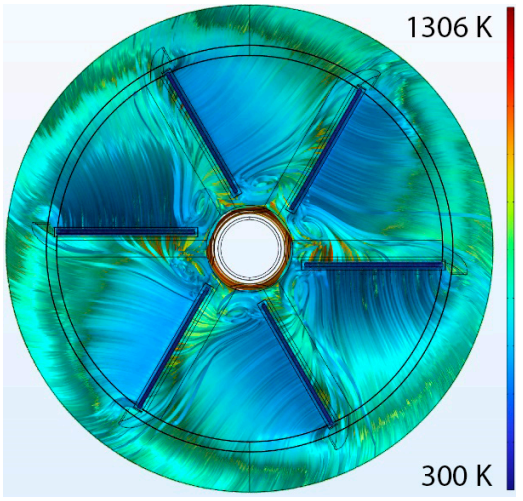
**S2. Fluid flow study, hydrogen**



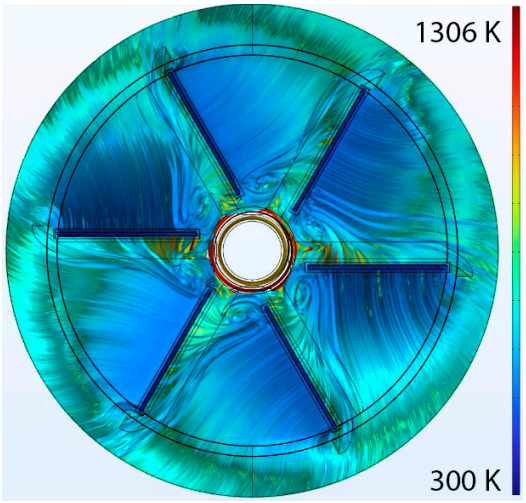

(a) Inlet velocity of 0.5 m/s for $H_2$, 10 atm, 100 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 10 atm, 100 rpm

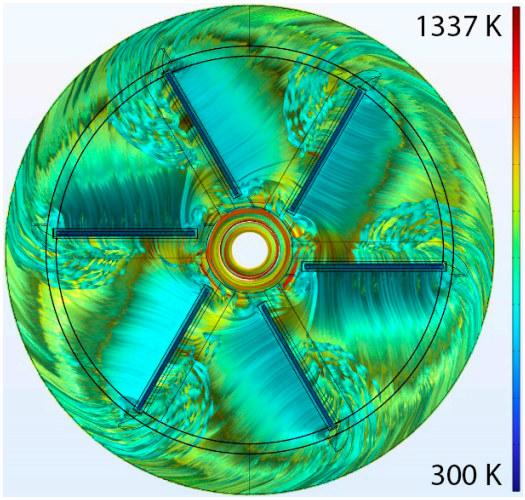



(c) Inlet velocity of 0.7 m/s for $H_2$, 10 atm, 100 rpm

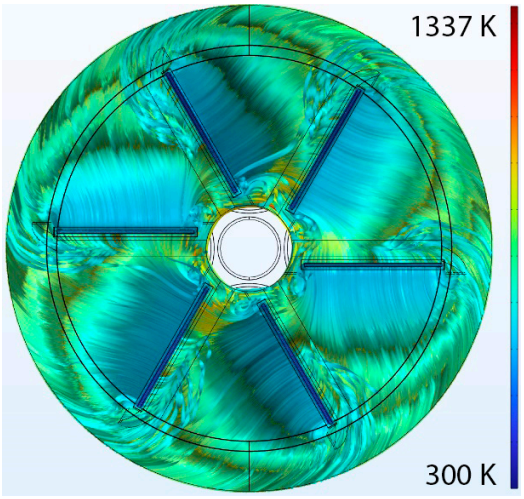



(d) Inlet velocity of 0.8 m/s for $H_2$, 10 atm, 100 rpm

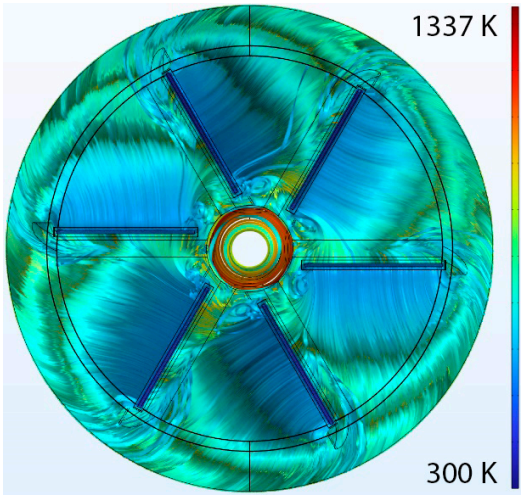
Figure S10. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 10 atm pressure. The disk rotates at 100 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1306 K (red).



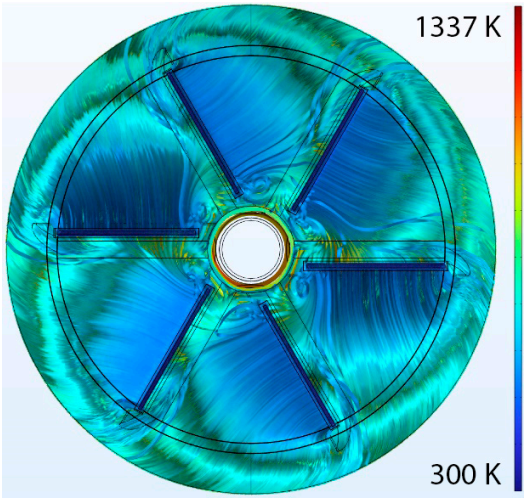

(a) Inlet velocity of 0.5 m/s for $H_2$, 10 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 10 atm, 200 rpm

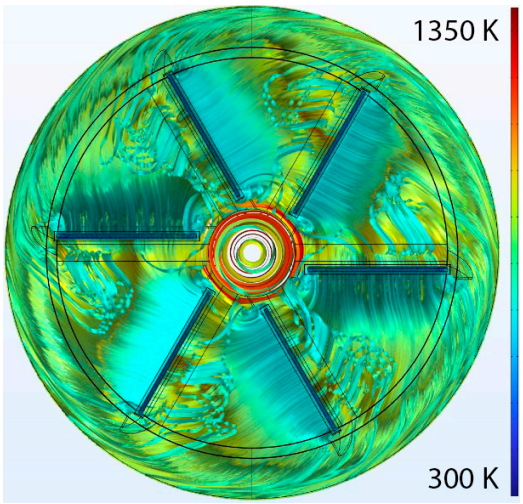



(c) Inlet velocity of 0.7 m/s for $H_2$, 10 atm, 200 rpm

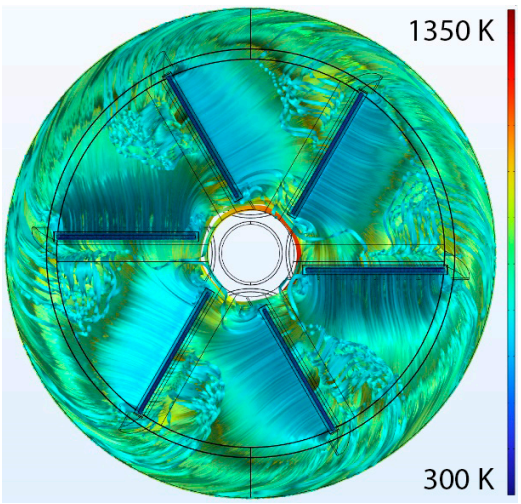



(d) Inlet velocity of 0.8 m/s for $H_2$, 10 atm, 200 rpm

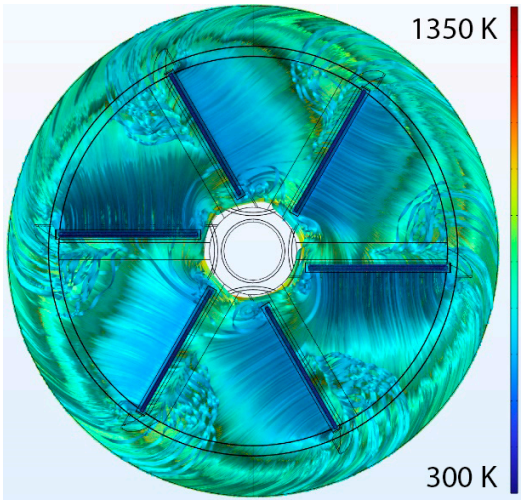
Figure S11. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 10 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1337 K (red).



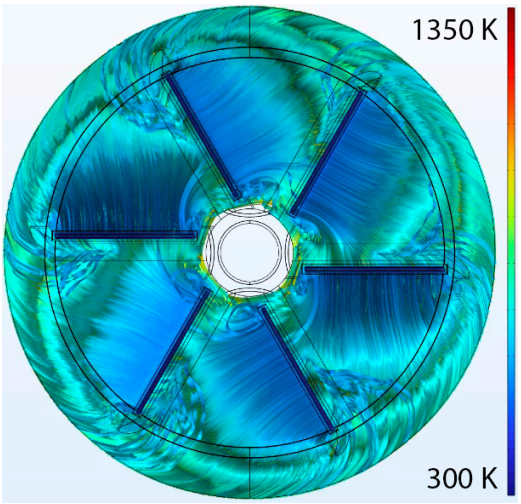

(a) Inlet velocity of 0.5 m/s for $H_2$, 10 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 10 atm, 300 rpm

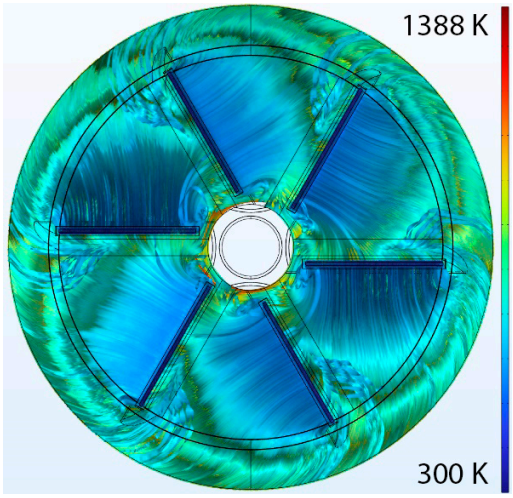



(c) Inlet velocity of 0.7 m/s for $H_2$, 10 atm, 300 rpm

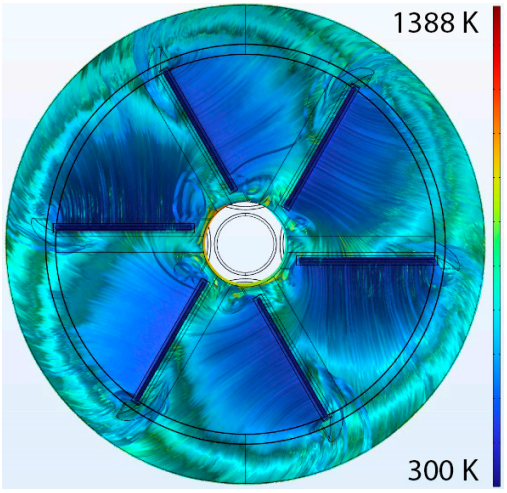



(d) Inlet velocity of 0.8 m/s for $H_2$, 10 atm, 300 rpm

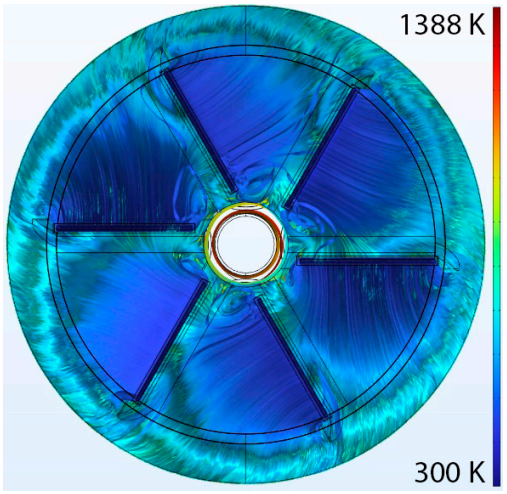
Figure S12. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 10 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1350 K (red).



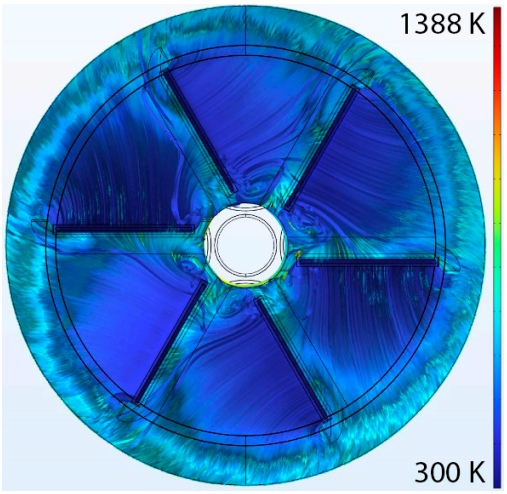

(a) Inlet velocity of 0.5 m/s for $H_2$, 20 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 20 atm, 200 rpm

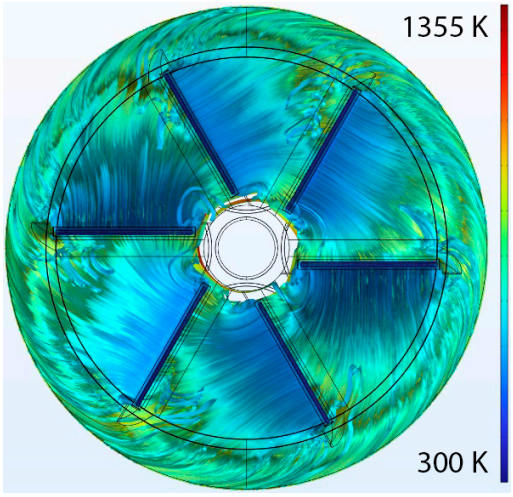



(c) Inlet velocity of 0.7 m/s for $H_2$, 20 atm, 200 rpm

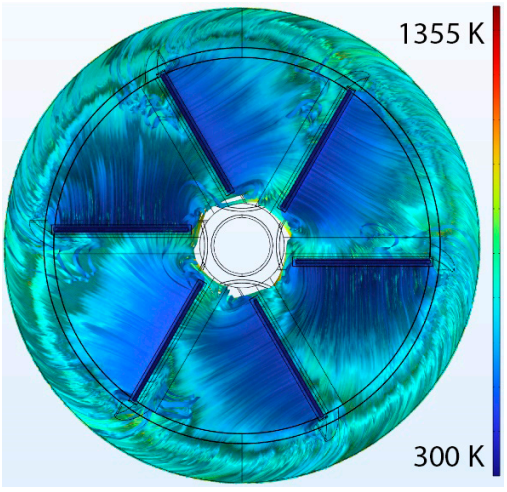



(d) Inlet velocity of 0.8 m/s for $H_2$, 20 atm, 200 rpm

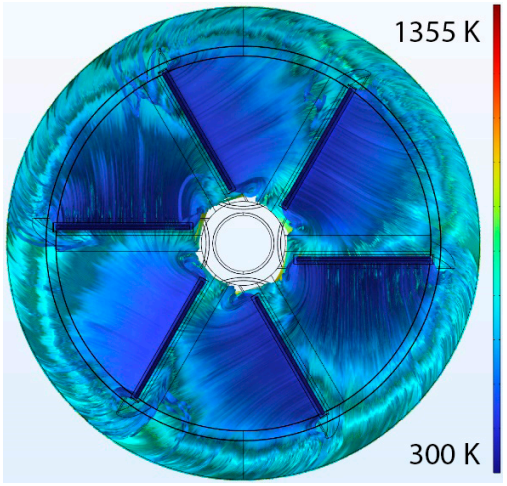
Figure S13. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 20 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1388 K (red).



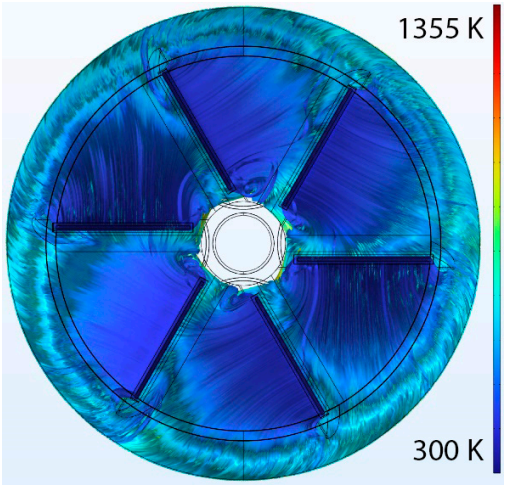

(a) Inlet velocity of 0.5 m/s for $H_2$, 20 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 20 atm, 300 rpm

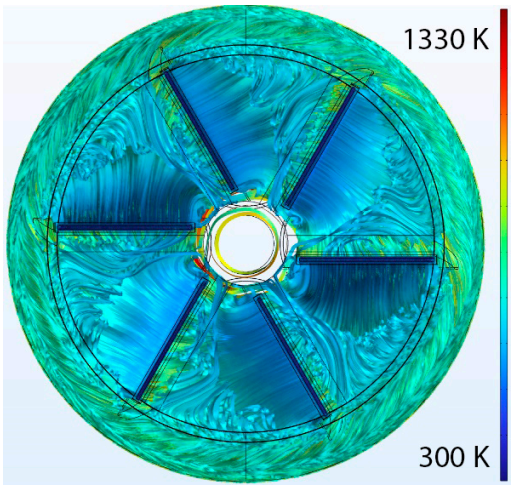



(c) Inlet velocity of 0.7 m/s for $H_2$, 20 atm, 300 rpm

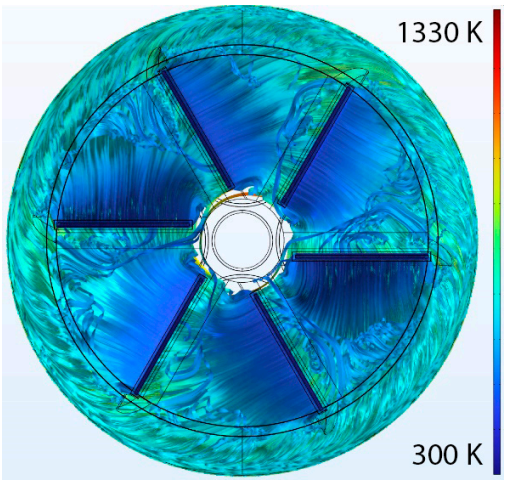



(d) Inlet velocity of 0.8 m/s for $H_2$, 20 atm, 300 rpm

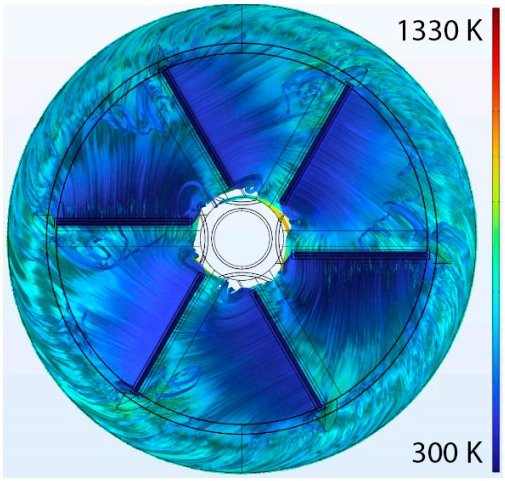
Figure S14. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 20 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1355 K (red).



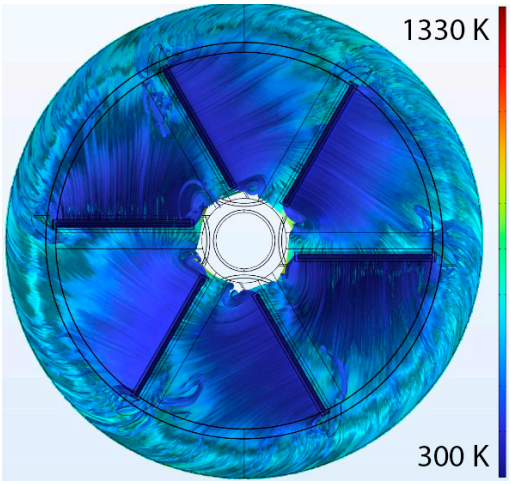

(a) Inlet velocity of 0.5 m/s for $H_2$, 20 atm, 400 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 20 atm, 400 rpm

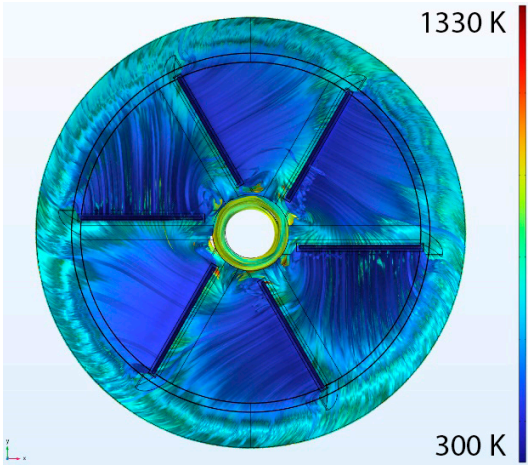



(c) Inlet velocity of 0.7 m/s for $H_2$, 20 atm, 400 rpm

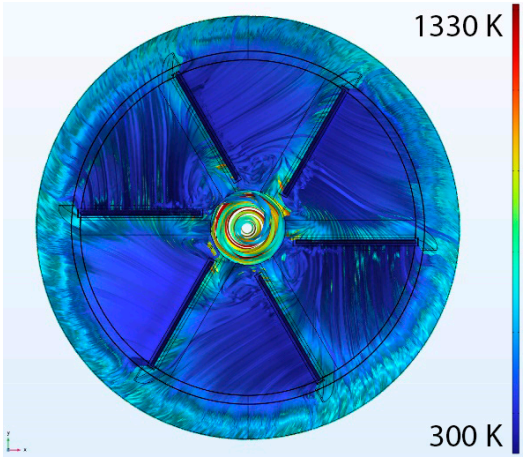



(d) Inlet velocity of 0.8 m/s for $H_2$, 20 atm, 400 rpm

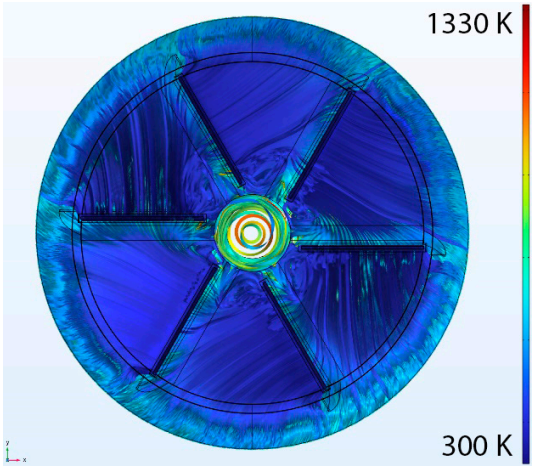
Figure S15. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 20 atm pressure. The disk rotates at 400 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1330 K (red).



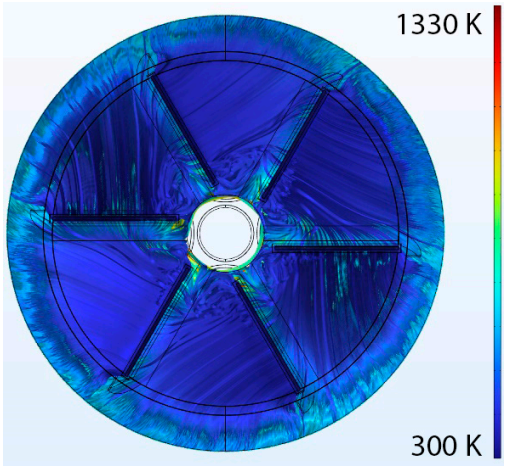

(a) Inlet velocity of 0.5 m/s for $H_2$, 30 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 30 atm, 200 rpm

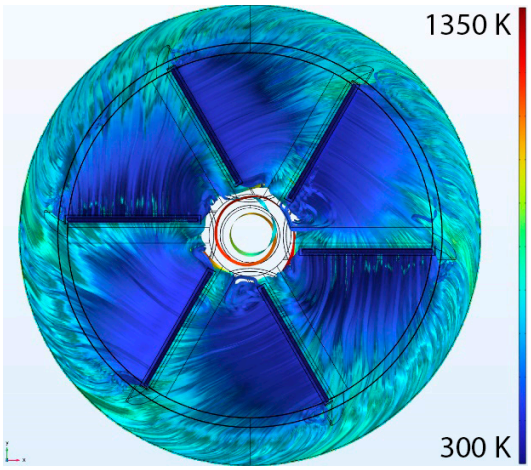



(c) Inlet velocity of 0.7 m/s for $H_2$, 30 atm, 200 rpm

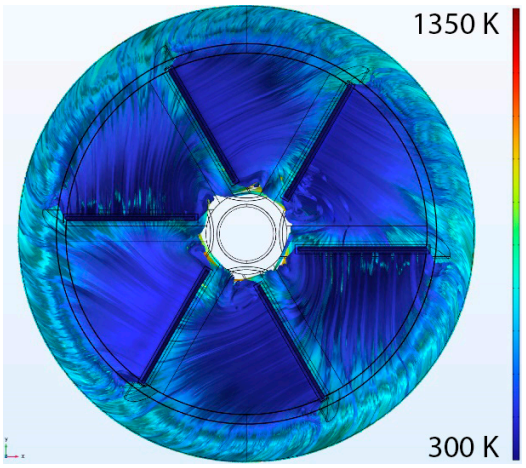



(d) Inlet velocity of 0.8 m/s for $H_2$, 30 atm, 200 rpm

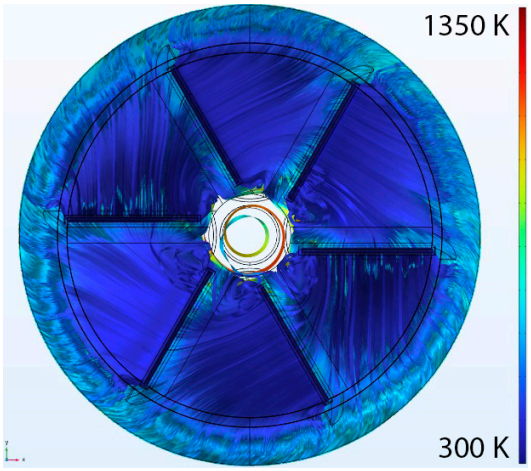
Figure S16. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 30 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1330 K (red).



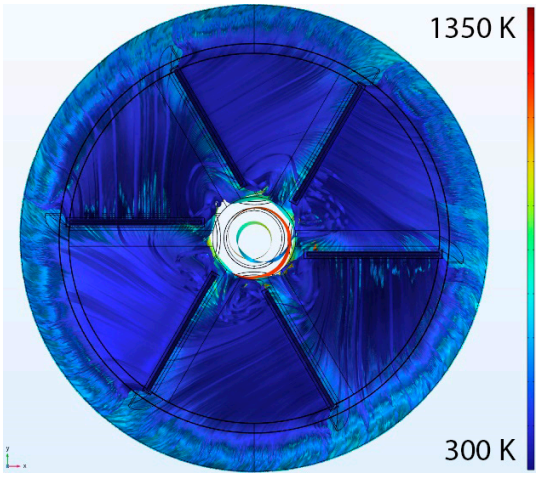

(a) Inlet velocity of 0.5 m/s for $H_2$, 30 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 30 atm, 300 rpm

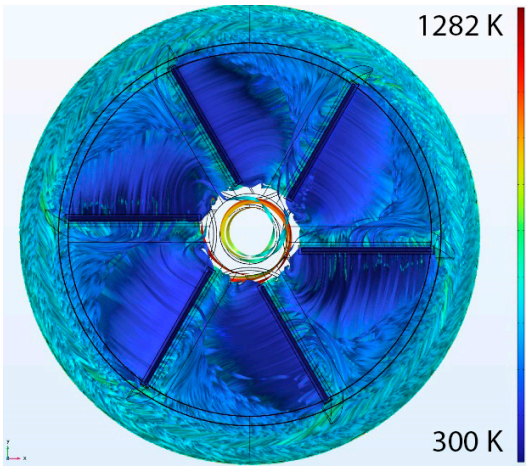



(c) Inlet velocity of 0.7 m/s for $H_2$, 30 atm, 300 rpm

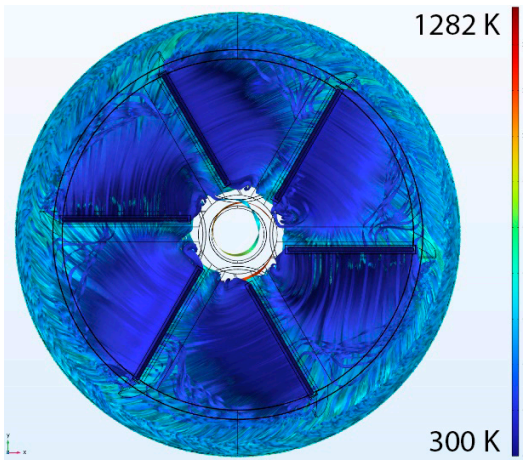



(d) Inlet velocity of 0.8 m/s for $H_2$, 30 atm, 300 rpm

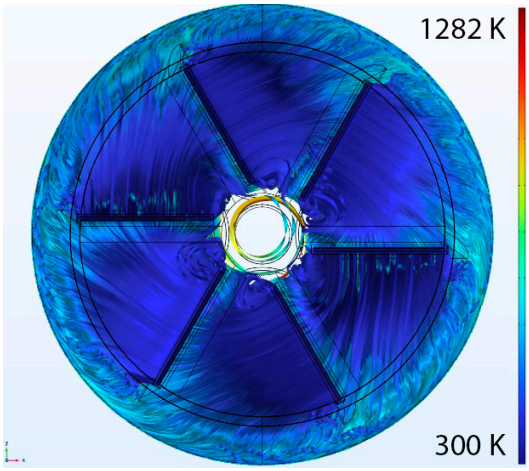
Figure S17. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 30 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1350 K (red).



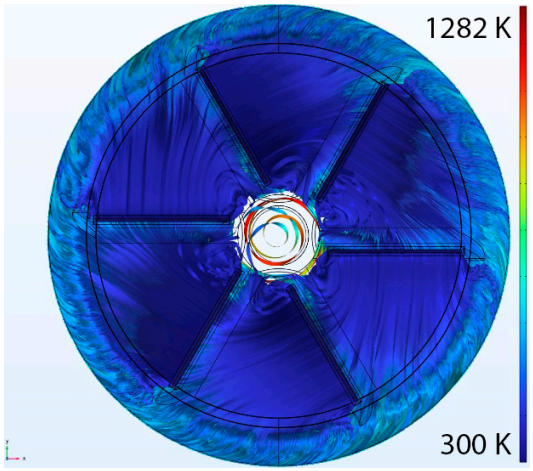

(a) Inlet velocity of 0.5 m/s for $H_2$, 30 atm, 400 rpm




(b) Inlet velocity of 0.6 m/s for $H_2$, 30 atm, 400 rpm



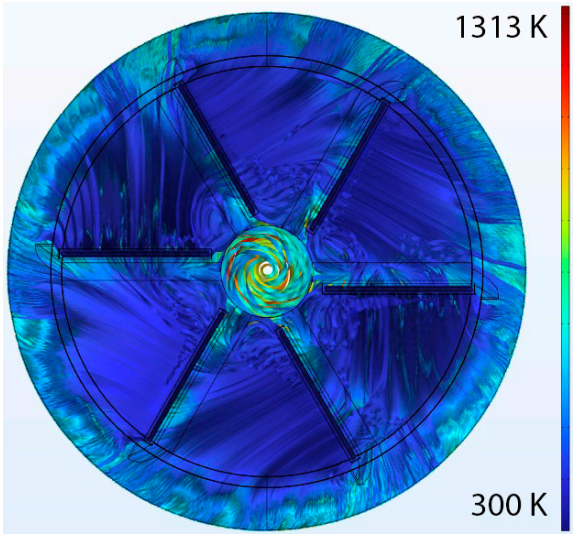

(c) Inlet velocity of 0.7 m/s for $H_2$, 30 atm, 400 rpm



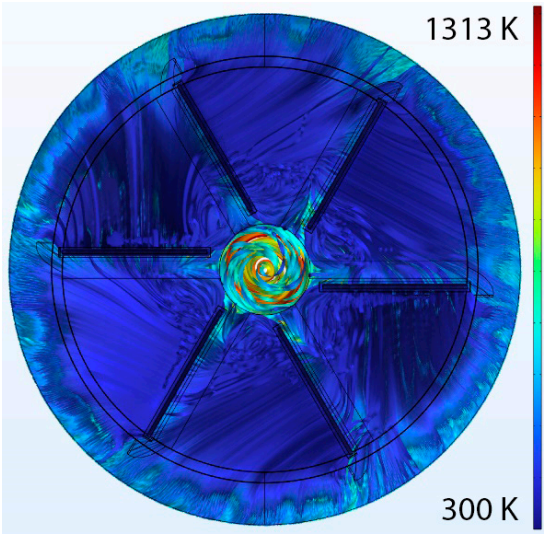

(d) Inlet velocity of 0.8 m/s for $H_2$, 30 atm, 400 rpm

Figure S18. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $H_2$ at 30 atm pressure. The disk rotates at 400 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1282 K (red).

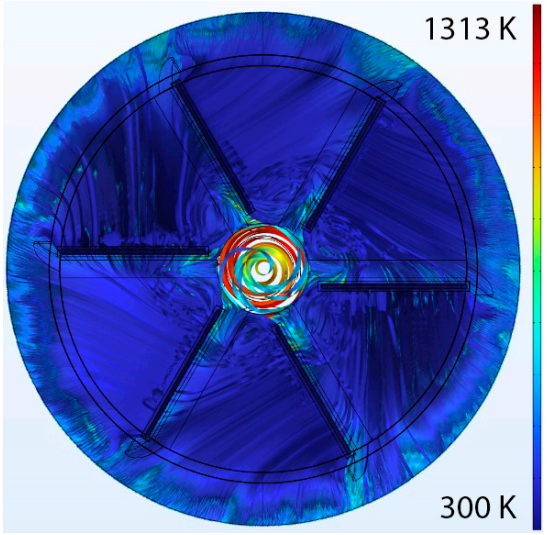
**S3. Fluid flow study, ammonia**



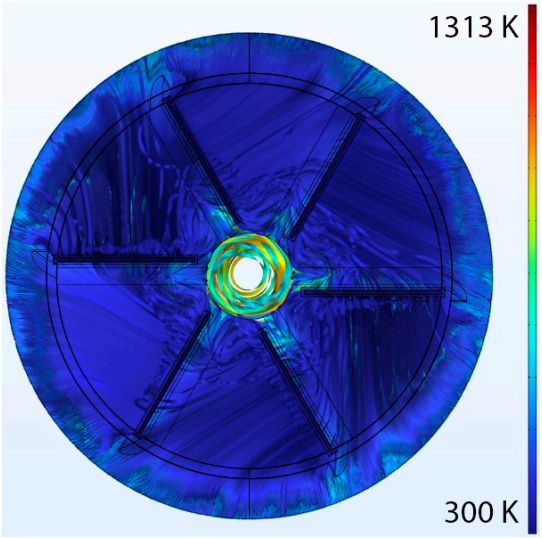

(a) Inlet velocity of 0.5 m/s for $NH_3$, 10 atm, 200 rpm




(b) Inlet velocity of 0.6 m/s for $NH_3$, 10 atm, 200 rpm

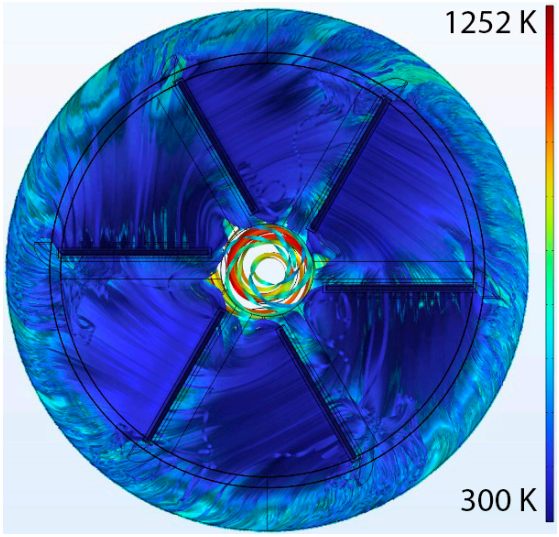



(c) Inlet velocity of 0.7 m/s for $NH_3$, 10 atm, 200 rpm

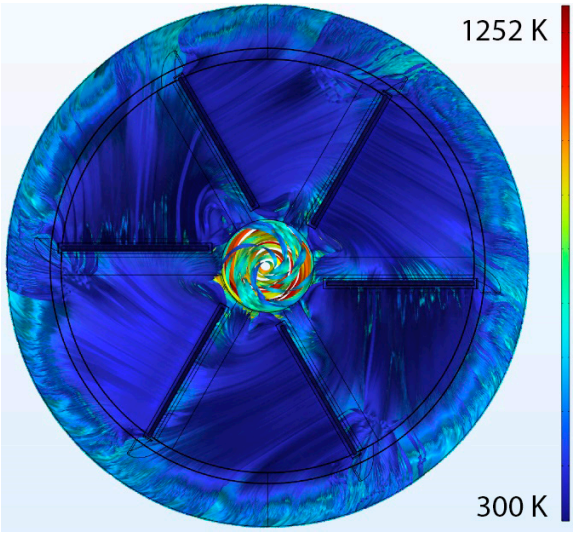



(d) Inlet velocity of 0.8 m/s for $NH_3$, 10 atm, 200 rpm

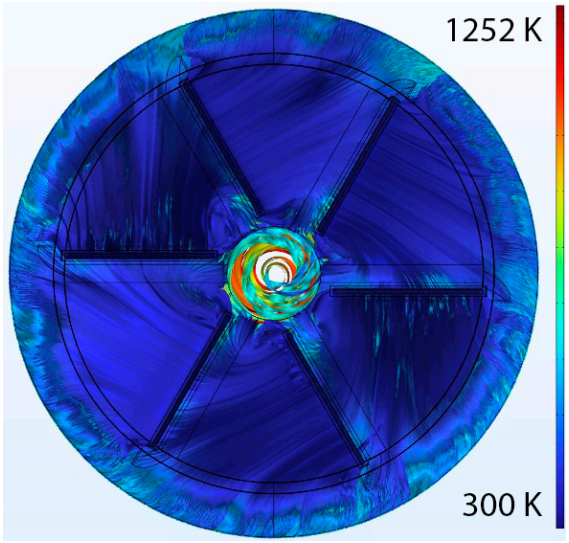
Figure S19. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $NH_3$ at 10 atm pressure. The disk rotates at 200 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1313 K (red).



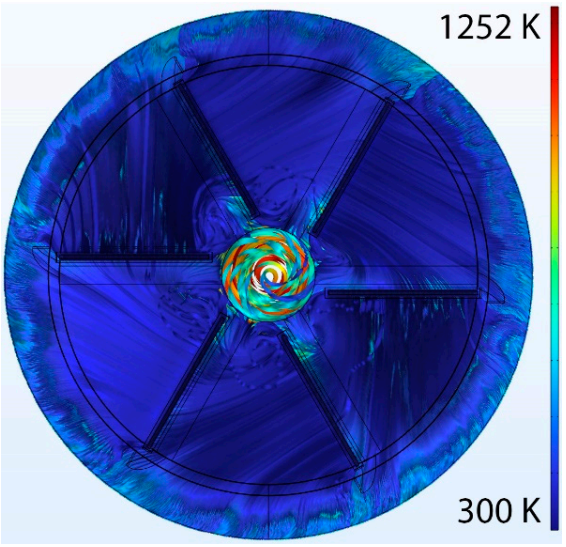

(a) Inlet velocity of 0.5 m/s for $NH_3$, 10 atm, 300 rpm




(b) Inlet velocity of 0.6 m/s for $NH_3$, 10 atm, 300 rpm

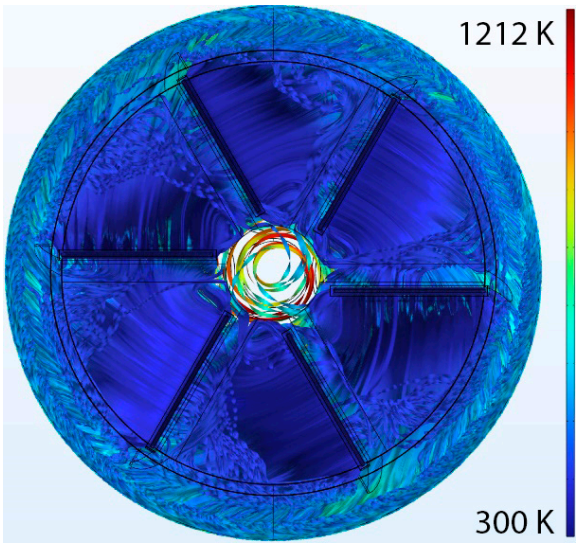



(c) Inlet velocity of 0.7 m/s for $NH_3$, 10 atm, 300 rpm

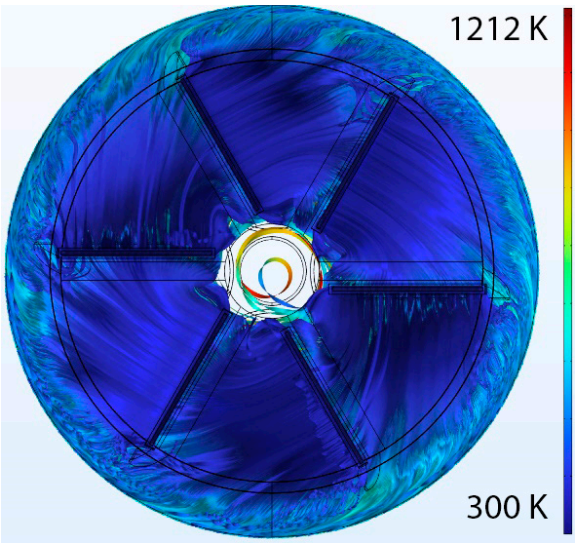



(d) Inlet velocity of 0.8 m/s for $NH_3$, 10 atm, 300 rpm

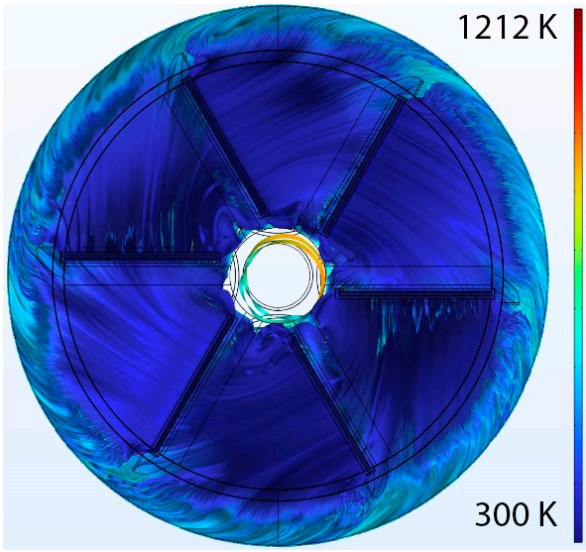
Figure S20. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $NH_3$ at 10 atm pressure. The disk rotates at 300 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1252 K (red).



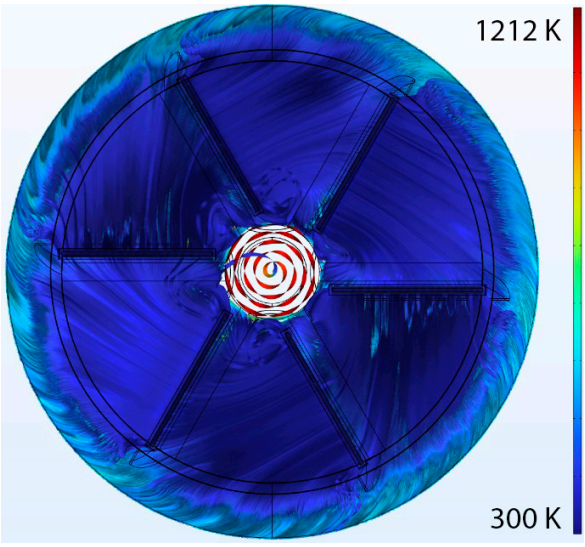

(a) Inlet velocity of 0.5 m/s for $NH_3$, 10 atm, 400 rpm




(b) Inlet velocity of 0.6 m/s for $NH_3$, 10 atm, 400 rpm




(c) Inlet velocity of 0.7 m/s for $NH_3$, 10 atm, 400 rpm




(d) Inlet velocity of 0.8 m/s for $NH_3$, 10 atm, 400 rpm

Figure S21. A top-down depiction showing 10,000 velocity streamlines color-coded according to temperature within the chambers, under the conditions of $NH_3$ at 10 atm pressure. The disk rotates at 400 rpm, while gas is introduced at inlet velocities of (a) 0.5 m/s, (b) 0.6 m/s, (c) 0.7 m/s, and (d) 0.8 m/s. Gas temperature is consistently color-coded across all panels, varying from 300 K (blue) to 1212 K (red).