Category: **Didactics**

Project: **Explaining Li-ion battery improvements (motion graphic)**

What was the challenge?

Although basic working principles of Li-ion battery is illustrated diagrammatically before, it is challenging to explain the subtleties that go into “improving” them to a broad audience. IMR at SUNY Binghamton wanted to visually explain the underlying principles of lithium intercalation at the atomic level given that their member Stanley Whittingham received the 2020 Nobel prize in chemistry for developing the lithium ion battery. They wanted to make a scientifically rigorous explanation of of the Li-ion battery to a range of stakeholders—from college students and researches to the private and public decision-makers—by utilizing infographics.

The brief was to create a motion graphic that would show how a battery powers a device during discharge **while showing how charge moves at the atomic level during discharging to highlight the materials properties that ultimately determine the battery’s performance**. The graphic would begin at the human scale showing a visible battery inside a wristwatch, then zoom into the battery’s microscopic and atomic layers to show how the subtleties of its structure effected the battery’s functions. This infographic would serve to guide education, research, and public dissemination of battery science.

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https://youtu.be/alJGuc5OtFE

What was the solution?

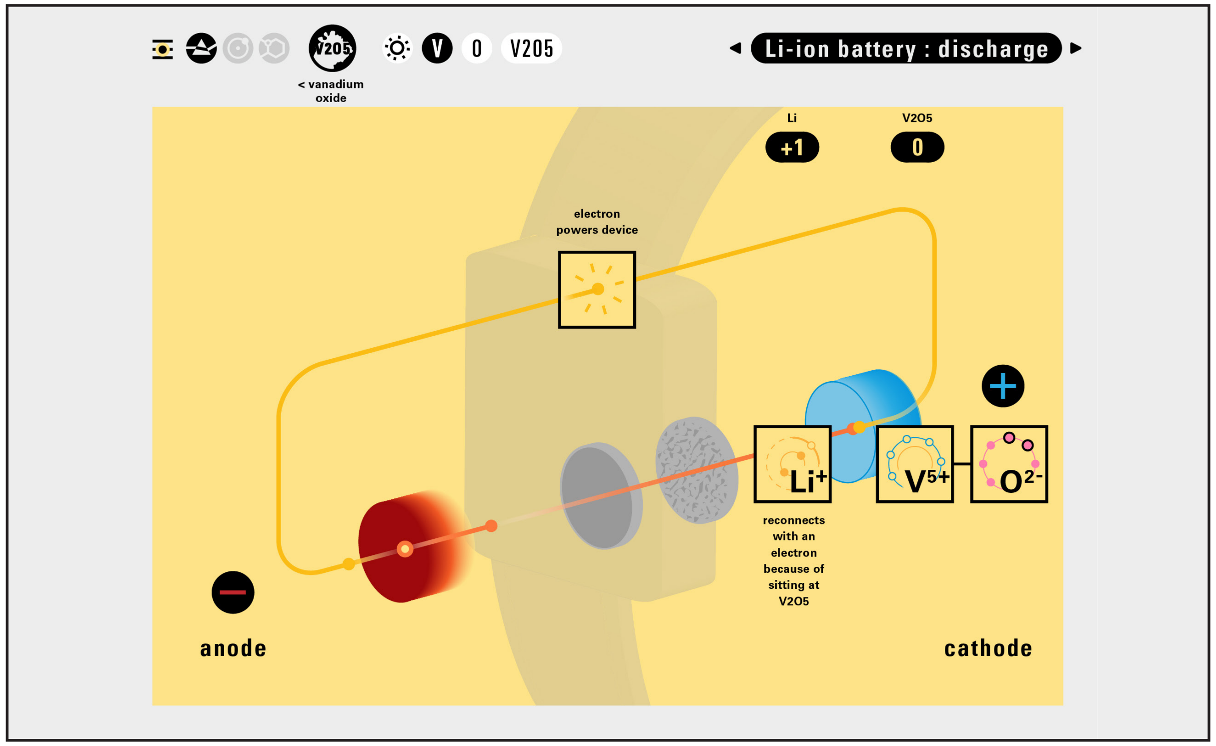
Design strategy and framework :
A design session was established at the IMR between designer Ersan and material scientists led by Louis Piper in which a visual strategy was created that would guide viewers from the visible down to the atomic levels of the Li-ion battery. A compositional framework was created that displayed the wristwatch and exploded-view of its battery on the background. Over this background, inset frames were overlaid to show zoom-in views of battery components at relevant scales.

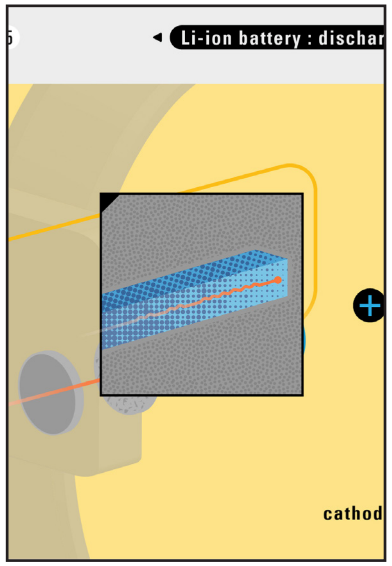
Visual Language and Storyboard:
Subsequent design sessions were established at the IMR between designer Ersan and Louis Piper to develop a visual language for the scientific components and to flesh out the visual story and to storyboard the animation.
A visual language was established to express atoms at three scales taking inspirations from cutting-edge published results in the literature. Atom’s electronic structure was portrayed by the Bohr (spdf orbital) model. Crystal structure was referenced from scientific modeling software Vesta. The dynamic motions of the crystal lattice was informed by quantum mechanical computations and modeling. Microstructures (nanowires) were referenced from SEM imagery, and solutions to quantum mechanical calculations were reproduced from https://doi.org/10.1038/ncomms12022. All of these elements were built as vector graphics.

Animation and motion graphics
Crucial motion graphics were created within Adobe AfterEffects. All of the vector and motion-graphics elements were brought together and animated on AdobePremiere Pro. The final animation shows how Lithium atoms split into electrons that feed the wristwatch as well as lithium ions that move from the negative pole of the battery towards the positive end. Battery is drained after all lithium ions migrate to the positive end. Several inset frames show in detail the performance of the nanowire in facilitating lithium’s movement.

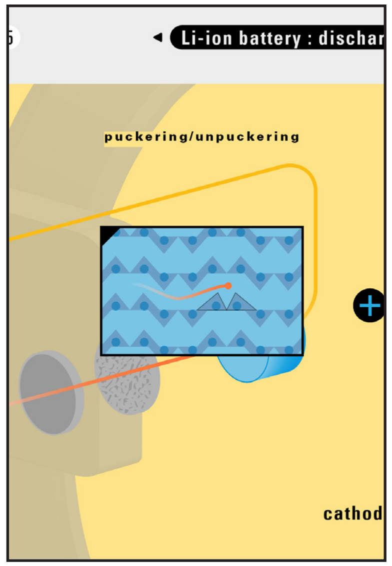
What was the effect?

Infographics of lithium ion batteries focus on the lithium ions shuttling back and forth between electrodes, but this infographic includes the ionic and electronic motion within the electrode. This motion graphic not only reveals how the capacity of the battery is related to the ability of the cathode to store lithium, it emphasizes how the atomic structure of the electrode can limit the capacity i.e. inhomogeneous insertion. It is then intuitive to the audience that modifying the geometric structure can facilitate easier lithium insertion resulting in better/ faster batteries. Before this graphic came to life, it was a thoroughly challenging effort to explain the multiple levels of materials science and engineering required to develop next-generation batteries to multiple stakeholders.

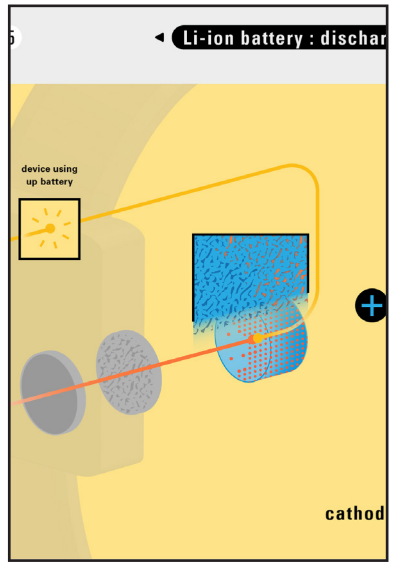




Inset frame showing a single Lithium ion moving through a nanowire that resides within battery’s positive end (cathode).



Inset frame showing Lithium ion causing nearby atoms to pucker while passing through the nanowire.



Inset frame showing Lihium ions filling up battery’s cathode.