

“The Material Evolution Revolution”

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Abstract:

Traditionally we design materials with exactly the properties we want and try to make them stable for decades – we intentionally avoid mutations. This means that we avoid degradation processes like rusting, cracking and warping, but we also exclude the possibility that materials improve over time or adapt to their environment. The idea of a bridge becoming more stable or a computer becoming faster with use may sound absurd, but such performance enhancements over time are a hallmark of biological evolution. We are not surprised now that AI models become better over time and even design them to evolve and improve, so why don't we take such an approach with materials and devices? This lecture describes the requirements for such evolvable materials and proposes spatiotemporal patterning of light as a tool to direct the evolution of halide perovskites. It begins by highlighting the ways that light can both control and measure the properties in space and time. I will then show several examples of adaptable, self-optimizing and (re)programmable functions of halide perovskites and our first results on materials that display memory and elements of learning. I will end with my vision for the material evolution revolution and the possibility it presents to make and measuring billions of solar cells each day.