Poster Number: 8; Poster Presentation Session 1

Mind Over Matter

Author(s):
Michael Bowen, Chemical and Biomolecular Engineering, NC State University

Mentor(s):
Milad Abolhasani, College of Engineering, NC State University

Inspired by biological processes, artificial neural networks (NNs) and computer-simulated genetic algorithms are affordable, accurate approaches for rapid input/output parameter space mapping and optimization of complex, multi-variable processes with large, diverse data sets. In this project, we capitalize on the wealth of experimentally obtained optical properties of colloidal semiconductor nanocrystals, known as quantum dots (QDs), using a modular automated flow synthesis platform to precisely map the synthesis input conditions to the final optical attributes of the nanocrystals (e.g. emission bandgap, size distribution, and quantum yield). Such NN frameworks can enable *on the fly* optimization and on demand synthesis of high-quality QDs with desired optical properties tailored toward a target application in optoelectronic devices. A recurrent NN was created by integrating a feed-forward NN with genetic algorithm and/or gradient loss functions to select "guess sets" of inputs for experimentation. The "fitness" of each set was determined by an error function comparing its predicted output to a "optimal" set of values. The "fittest" sets were automatically tested in an automated microfluidic platform, after which the results were used to retrain the NN. This process was repeated until a predetermined error threshold was achieved, effectively enabling *fully autonomous* synthesis of high-quality QDs at a throughput relevant to large-scale photovoltaic manufacturing. Continuous nano-manufacturing of monodispersed, high quality, and colloidally stable QDs has implications in affordable, accessible photovoltaics, LEDs, and Solid-State Lighting worldwide, and the modularity and versatility of this approach will allow other solution-phase processes to similarly be optimized *in flow.*