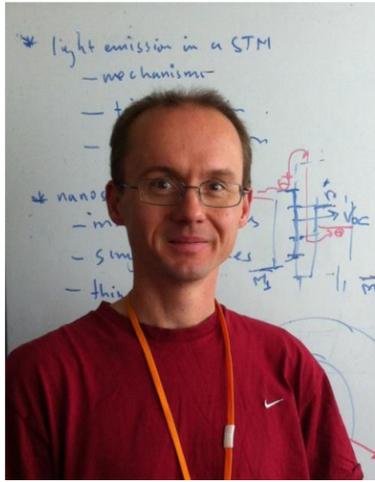




# BIG energy seminar series

Addressing the scale and complexity of the global energy challenge.



## Excitons and Plasmons in Nanoscale Systems

**Dr. van de Lagemaat**

Principal Scientist – Group Manager  
Chemical and Materials Sciences Center  
National Renewable Energy Laboratory

**Thursday, October 25<sup>th</sup> at 12:00 PM**

**Duane Physics Building, Room D142**

**Summary:** Due to growing populace and standard of living, many terawatts of energy will be needed in the near future. The sun is the largest source of carbon-neutral and renewable energy that we have available and it is the only source that can provide terawatts of energy without depleting rapidly or causing major environmental and climate concerns. To fulfill this role, revolutionary approaches to solar energy conversion are needed that provide energy at very high efficiency at very low prices. The unique properties of self-organic and nanoscale systems possibly enable such a future by combining ease of processing and low cost with third-generation photoconversion processes that enable high efficiency.

Examples of third generation photoconversion involve semiconductor quantum dots, carbon nanostructures and organic semiconductors. The presence of excitonic states in these systems at room temperature allows for processes such as multiple exciton generation, singlet fission and long-range energy transfer that are currently being researched for applications in the next generation of high efficiency solar energy conversion. These processes have been theorized to allow for the breaking of traditional limits to solar cell efficiency. However, much remains unknown about how to control these processes. A new approach to this control, which will be discussed in this talk, involves the coupling between excitons and surface plasmons in nanoscale systems and allows for the outcome of photoexcitation to be directed to a desired final state that most optimally converts sunlight into electrical energy or fuels. Approaches such as this can possibly drive future solar cell efficiencies above traditional barriers and provide one avenue to solving the energy problem.

## Dr. van de Lagemaat

Dr. van de Lagemaat received his PhD in 1998 from the University of Utrecht. He worked on the exciton dynamics, charge transport properties, and the physical and chemical properties of interfaces of large-band-gap semiconductors such as SiC, GaP, GaN, and diamond. From 1998 to 2001, he worked as a postdoctoral researcher at NREL. His studies focused on charge transport and recombination in dye-sensitized solar cells. His papers in this field have proven seminal to the understanding of this unique system. From 2001 to the present, he has worked as a scientist at NREL on the energetics and transport properties of single semiconductor nanoparticles (quantum dots) and arrays of nanoparticles using tunneling spectroscopy and microscopy, transient photocurrent, transistor measurements, and computer modeling. He is currently a Principal Scientist and group manager at NREL and is researching tunneling-induced luminescence and plasmon-resonance imaging of individual quantum dots, the interaction between carbon nanotubes and organic semiconductors, and the use of plasmonic-enhancement effects in solar energy conversion systems. He is also a fellow of the Renewable and Sustainable Energy Institute at the University of Colorado Boulder.

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