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UWill Discover Undergraduate Conference

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Mar 24th, 1:00 PM - 1:50 PM

### Tuneable Optical Transmission of Glass Substrates Using Gold Nanoparticles

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Mathers, Melissa, "Tuneable Optical Transmission of Glass Substrates Using Gold Nanoparticles" (2015). *UWill Discover Undergraduate Conference*. 18.  
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## UWill Discover Undergraduate Research Conference Proposal

**Title:** Tuneable Optical Transmission of Glass Substrates Using Gold Nanoparticles

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**Type of Proposal:** Oral Presentation

**Importance of the Project:** This project is focused on improving the absorption capabilities of thin-film solar cells, which has the potential to revolutionize the renewable energy industry by increasing the efficiency of affordable photovoltaic technologies.

**Existing State of Knowledge:** Traditional crystalline silicon (c-Si) solar cells are inefficient with only 22%-25% of incident light being converted to electricity. Forty percent of the cost of manufacturing c-Si cells can be attributed to the cost of the semi-conducting layer. [1] Efforts to reduce this cost resulted in reducing the thickness of the active layer, which in turn further reduced efficiency. Currently, various research teams are working to develop light trapping mechanisms (Beck, Poleman, Catchpole) and charge separation techniques (Thomann) to improve the efficiencies of the less-expensive thin-film solar cells.

[1] K. Catchpole and A. Polman, "Plasmonic solar cells," Opt. Express 16, 21793-21800 (2008).

**Research Question:** Can we optimize electron generation by tuning light incident on the surface of the cell to better match the absorption spectrum of the active layer?

**Methodology:** It is well known that the size of gold nanoparticles and the spacing between them in an array can alter localized electric fields. [2] Computational software and mathematically analytic methods will be used to optimize the radius to distance ratio of spherical gold nanoparticles in an array to match transmitted light to the absorption spectrum of the active layer.

[2] Design principles for particle plasmon enhanced solar cells  
Catchpole, K. R. and Polman, A., Applied Physics Letters, 93, 191113 (2008)

**Findings:** Data analysis and certain simulations are still in progress. The preliminary results will be presented for the Internal Quantum Efficiency (IQE) of a cell, over the range ratios of particle radius  $a$ , to spacing  $d$ , from  $(a/d) = 0.071$  to  $(a/d) = 2.5$ . The theoretical results for absorption as a function of this same ratio will also be presented.