

1. **Research Title:** Biomolecular interaction of Plasmonic Nanostructures With Different Geometries
2. **Individual Sponsor:** Name: Saber Hussain, PhD  
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3. **Academic Area/Field and Education Level:** Materials Science and Engineering, Chemical Engineering (working toward M.S. or Ph.D.)
4. **Objectives:** Study plasmonic nanostructures with different geometries designed to tune optical properties for intracellular delivery and sensor applications.
5. **Description:** The Air Force (AF) is investigating recent advances in nanomaterial research to address human performance by developing intracellular sensor and delivery systems. Our key interest is to tune the plasmon peak absorption and scattering wavelength to the near infrared, which is within the window of transparency of biological tissue (800 nm-1100 nm). Gold is of particular interest due to its stability and facile modification *via* thiol chemistry, enabling conjugation to biomolecules for specific targeting, uptake, and delivery (Aliklany et al., 2009). Efforts are currently being pursued to investigate different aspect ratios of gold nanorods and their interactions in biological systems. Gold nanoshells also exhibit tunable absorption in the near infrared and react uniquely to external radio frequency stimulus (Loo et al., 2004). In order to develop nanostructures for AF applications and to ensure their safety for implementation, it is important to understand how different physical and chemical properties affect their interaction in biological systems. This project will involve synthesis and functionalization of plasmonic nanostructures with different geometries and investigating their biomolecular interactions using *in vitro* cell models.
6. **Potential Commercial Impact and Industry Involvement:** Technologies developed under this topic have significant future research potential within several Air Force Research Laboratory technical directorates, academia, and small business. This information will support the integration of nanostructures for Air Force intracellular sensing and delivery applications and provide information necessary to take proactive measures for environmental health and safety. Specialized research in this topic area is suited well for military, medical, and commercial applications in the future.
7. **Research Classification/Restrictions:** This research is considered Unclassified.

8. **Interested in Summer USAFA Cadet (Avg Cost for USAF Cadet for 33 days ~ \$4000):**  
Yes                      No

9. **Eligible Research Institutions:** Select all that apply.

X Universities (DAGSI)      X AFIT (only)      X USAFA

10. **References**

Alkilany AM, Nagaria PK, Hexel CR, Shaw TJ, Murphy CJ, Wyatt MD. Cellular uptake and cytotoxicity of gold nanorods: Molecular origin of cytotoxicity and surface effects. *Small-Journal* 6 (2009): 701-708.

Loo, C.; Lin, A.; Hirsch, L.; Lee, M.; Barton, J.; Halas, N.; West, J.; Drezek, R. Nanoshell-enabled photonics-based imaging and therapy of cancer. *Technology in Cancer Research & Treatment* 3 (2004): 33-40.

**Overview:**

