Mitacs : Literature References

Daniel Joel Gracias

August 2023

1 Silanization of AuNPs

- Buining et al [4] synthesized ethanolic < 5nm AuNP by reducing $HAuCl_4$ in the presence of MTMPS, which is further functionalized with APTES to obtain a N-terminated, double layer cage structure.
- Lai et al [12] capped CTAB capped GNRs with MTMPS with the objective of functionalizing with PEG for improving bio compatibility. Functionalization was carried out by adding an isopropanol solution of MTMPS directly into the AuNP and letting it react for 24h. Other works have also used MTMPS as an interface between AuNPs and other polymer matrices such as polyamic acid [1], polyacrylate [5] and polystyrene [6]
- MTMPS has been used to create interfaces between AuNPs and silicate matrices dervided from tetraorthosilicate (TEOS) [11] [15] and N-[3-(trimethoxysilyl)propyl] ethylenediamine (EDAS) [3]. Numerous other instances of MTMPS being used to stabilize interface between silicate and AuNPs [9][14], as well as other NPs [10].
- Bifunctional alkoxysilanes have also been used to functionalize oxide substrates to enable coating of AuNP sols [2][20]
- He et al [8] developed a strategy to remove CTAC from AuNPs using $NaBH_4$ and replacing it with a thiol ligand (11-mercaptoundecanoic acid)

2 FTIR Assignment

- FTIR-ATR spectra of pure MTMPS was obtained from Spectrabase.com
- Rubio et al [19] analysed siloxane condensation of APTMS under FTIR
- Buining et al [4] condensed APTES and MTMPS
- Launer et al [13] reviewed the various possible observable IR peaks corresponding to silicon substituents in organic compounds

3 Seed Mediated Synthesis

- Experimental procedure for synthesis of AuNPs [23].
- Function of various reagents in seed mediated synthesis [18]

References

[1] Daniel Andreescu, Adam K Wanekaya, Omowunmi A Sadik, and Joseph Wang. Nanostructured polyamic acid membranes as novel electrode materials. *Langmuir*, 21(15):6891–6899, 2005.

[2] Barbara Ballarin, Maria Cristina Cassani, Erika Scavetta, and Domenica Tonelli. Self-assembled gold nanoparticles modified ito electrodes: The monolayer binder molecule effect. *Electrochimica Acta*, 53(27):8034–8044, 2008.

[3] S Bharathi, N Fishelson, and O Lev. Direct synthesis and characterization of gold and other noble metal nanodispersions in sol- gel-derived organically modified silicates. *Langmuir*, 15(6):1929–1937, 1999.

[4] Paul A Buining, Bruno M Humbel, Albert P Philipse, and Arie J Verkleij. Preparation of functional silane-stabilized gold colloids in the (sub) nanometer size range. *Langmuir*, 13(15):3921–3926, 1997.

[5] Chih-Ming Chang and Chao-Ching Chang. Preparation and characterization of polyimide–nanogold nanocomposites from 3-mercaptopropyltrimethoxysilane encapsulated gold nanoparticles. *Polymer degradation and stability*, 93(1):109–116, 2008.

[6] Muriel K Corbierre, Neil S Cameron, Mark Sutton, Khalid Laaziri, and R Bruce Lennox. Gold nanoparticle/polymer nanocomposites: dispersion of nanoparticles as a function of capping agent molecular weight and grafting density. *Langmuir*, 21(13):6063–6072, 2005.

[7] M Cutroneo, A Torrisi, V Ryukhtin, M Dopita, L Silipigni, A Mackova, P Malinsky, P Slepicka, and L Torrisi. Polydimethylsiloxane containing gold nanoparticles for optical applications. *Journal of Instrumentation*, 15(03):C03044, 2020.

[8] Jie He, Sarah Unser, Ian Bruzas, ReJeana Cary, Zhiwei Shi, Rajesh Mehra, Kenneth Aron, and Laura Sagle. The facile removal of ctab from the surface of gold nanorods. *Colloids and Surfaces B: Biointerfaces*, 163:140–145, 2018.

[9] Yusuke Ide, Atsushi Fukuoka, and Makoto Ogawa. Preparation of au nanoparticles in the interlayer space of a layered alkali silicate modified with alkylthiol groups. *Chemistry of materials*, 19(5):964–966, 2007.

[10] Nikhil R Jana, Christopher Earhart, and Jackie Y Ying. Synthesis of water-soluble and functionalized nanoparticles by silica coating. *Chemistry of Materials*, 19(21):5074–5082, 2007.

[11] Bernd Kutsch, O Lyon, M Schmitt, M Mennig, and H Schmidt. Investigations of the electronic structure of nanoscaled gold-colloids in sol-gel-coatings. *Journal of non-crystalline solids*, 217(2-3):143–154, 1997.

[12] Sarah Lai, Sonia Centi, Claudia Borri, Fulvio Ratto, Lucia Cavigli, Filippo Micheletti, Bjrn Kemper, Steffi Ketelhut, Tatiana Kozyreva, Leonardo Gonnelli, et al. A multifunctional organosilica cross-linker for the bioconjugation of gold nanorods. *Colloids and Surfaces B: Biointerfaces*, 157:174–181, 2017.

[13] Philip J Launer and Barry Arkles. Infrared analysis of organosilicon compounds: spectra-structure correlations. *Silicone compounds register and review*, 100:100–103, 1987.

[14] Luis M Liz-Marzán, Michael Giersig, and Paul Mulvaney. Synthesis of nanosized gold- silica core- shell particles. *Langmuir*, 12(18):4329–4335, 1996.

[15] Anthony Martino, Stacey A Yamanaka, Jeffrey S Kawola, and Douglas A Loy. Encapsulation of gold nanoclusters in silica materials via an inverse micelle/sol- gel synthesis. *Chemistry of materials*, 9(2):423–429, 1997.

[16] Javad Mirzaei, Martin Urbanski, Heinz-S Kitzerow, and Torsten Hegmann. Hydrophobic gold nanoparticles via silane conjugation: chemically and thermally robust nanoparticles as dopants for nematic liquid crystals. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 371(1988):20120256, 2013.

[17] PC Pandey and Ashish K Pandey. Functionalized alkoxysilane mediated synthesis of nano-materials and their application. *Advances in Bioceramics and Biotechnologies II*, page 155, 2014.

[18] Michelle L Personick and Chad A Mirkin. Making sense of the mayhem behind shape control in the synthesis of gold nanoparticles. *Journal of the American Chemical Society*, 135(49):18238–18247, 2013.

[19] Juan Rubio, Maria Alejandra Mazo, Araceli Mártin-Ilana, and Aitana Tamayo. Ft-ir study of the hydrolysis and condensation of 3-(2-amino-ethylamino) propyl-trimethoxy silane. *boletín de la sociedad española de cerámica y vidrio*, 57(4):160–168, 2018.

[20] Sandra Magalhães Saraiva and José Farias Oliveira. Colloidal gold particles adsorption onto silanized glass surfaces. *Journal of dispersion science and technology*, 25(2):229–237, 2004.

[21] Jay J Senkevich, Christopher J Mitchell, G-R Yang, and T-M Lu. Surface chemistry of mercaptan and growth of pyridine short-chain alkoxy silane molecular layers. *Langmuir*, 18(5):1587–1594, 2002.

[22] Anike H Virgili, Daniela C Laranja, Patrícia S Malheiros, Marcelo B Pereira, Tania MH Costa, and Eliana W de Menezes. Nanocomposite film with antimicrobial activity based on gold nanoparticles, chitosan and aminopropylsilane. *Surface and Coatings Technology*, 415:127086, 2021.

[23] Hsin-Lun Wu, Huei-Ru Tsai, Yun-Ting Hung, Ka-Un Lao, Ching-Wen Liao, Pei-Ju Chung, Jer-Shing Huang, I-Chia Chen, and Michael H Huang. A comparative study of gold nanocubes, octahedra, and rhombic dodecahedra as highly sensitive sers substrates. *Inorganic chemistry*, 50(17):8106–8111, 2011.

[24] Haoguo Zhu, Zhengwei Pan, Edward W Hagaman, Chengdu Liang, Steven H Overbury, and Sheng Dai. Facile one-pot synthesis of gold nanoparticles stabilized with bifunctional amino/siloxy ligands. *Journal of Colloid and Interface Science*, 287(1):360–365, 2005.