

THE WELCH FOUNDATION
RESEARCH GRANT PROGRAM
PROGRESS REPORT

Grant No. A-0960

Title of Research Complexes of Group 11 Elements, Especially Gold – Electronic and Molecular Structures and Reactivities

Grantee Institution Texas A&M University Department Chemistry

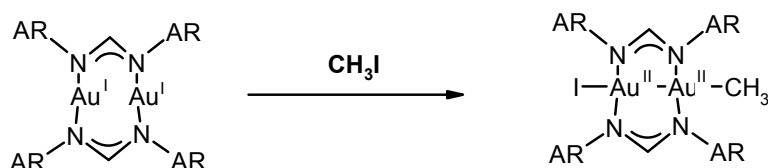
Principal Investigator John P. Fackler, Jr. Academic Rank Distinguished Professor

1. RESEARCH OBJECTIVE.

The preparation and characterization of new gold(I) compounds and clusters, especially those with Au-N bonds.

2. REPORT OF THE PROGRESS OF YOUR RESEARCH THIS GRANT YEAR. (In style of CHEMICAL ABSTRACTS, not over 200 words double spaced).

While textbooks generally suggest that Au-N bonded compounds are unstable or of limited stability, our group is learning that with nitrogen ligands having pi electron density this is not true. Indeed dinuclear, trinuclear and tetranuclear Au(I) compounds with Au-N bonds from amides, imides, pyrazolates and related compounds are being synthesized and characterized. Intercalation of an organic acid such as C₁₀F₈ has produced a new, strongly luminescent product which shows potential for the development of optical devices. The interaction of the new Au(I) compounds with oxide surfaces has afforded new ways to synthesize nanostructured catalysts. The dinuclear species are particularly interesting since they can undergo an oxidative-addition reaction (see figure) with formation of a metal-metal bond. One of these amidinate complexes has produced the shortest Au-Au bond observed to date, 2.47Å. Optical properties of these Au(I) compounds demonstrate the formation of an emissive excited electronic state, which is sensitive to the environment of the molecule.



AR = aromatic, CH₃I can be halogen

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APPROVED BY:

President

Date

Investigator (Signature)

Date

3. REFEREED PUBLICATIONS. List publications, in which the principal investigator is the author or co-author. First list names of authors as they appear on the reprint; then title of article; name of journal; volume; inclusive page numbers; and last the year in parentheses.

A. Refereed Articles as they appeared when published. (Articles reported in this section must have appeared in print, have acknowledged Welch Foundation support including the grant number, and have not previously been reported to the Foundation in this section. One copy of each article must be enclosed.)

Alfredo Burini, Ahmed A. Mohamed, John P. Fackler, Jr., "Cyclic Trinuclear Gold(I) Compounds: Synthesis, Structures and Supramolecular Acid-Base π -Stacks." *Comments on Inorganic Chemistry*, 24, 253-280, (2004).

Hanan E. Abdou, Ahmed A. Mohamed, Jose M. Lopez-de-Luzuriaga, John P. Fackler, Jr., "Tetranuclear Gold(I) Clusters with Nitrogen Donor Ligands: Luminescence and X-Ray Structure of Gold(I) Naphthyl Amidinate Complexes." *J. Cluster Science*, 15, 397-411, (2004).

Jinhua Chen, Ahmed A. Mohamed, Hanan E. Abdou, Jeanette A. Krause Bauer, John P. Fackler, Jr., Alice E. Bruce and Mitchell R. M. Bruce. "Novel metallamacrocyclic gold(I) thiolate cluster complex: structure and luminescence of $[\text{Au}_9(\mu\text{-dppm})_4(\mu\text{-p-tc})_6](\text{PF}_6)_3$." *Chem. Commun.*, 1575-1577, (2005).

Z. Yan, S. Chinta, Ahmed A. Mohamed, J. P. Fackler, Jr., and D.W. Goodman, "The Role of F-Centers in Catalysis by Au Supported on MgO." *Journal of the American Chemical Society*, 127, 1604-1605, (2005).

Ahmed A. Mohamed, Alfredo Burini, John P. Fackler, Jr., "Mixed Metal Triangular Trinuclear Complexes: Dimers of Gold-Silver Mixed-Metal Complexes from Gold(I) Carbeniates and Silver(I) 3,5-Diphenylpyrazolates." *Journal of the American Chemical Society*, 127, 5012-5013, (2005).

Hanan E. Abdou, Ahmed A. Mohamed, John P. Fackler, Jr., "Synthesis and X-ray Structures of Dinuclear and Trinuclear Gold(I) and Dinuclear Gold(II) Amidinate Complexes." *Inorg. Chem.*, 44, 166-168, (2005).

Hanan E. Abdou, Ahmed A. Mohamed, and John P. Fackler, Jr., "Oxidative Addition of Methyl Iodide to Dinuclear Gold(I) Amidinate Complex: Schmidbauer's Breakthrough Reaction Revisited with Amidinates." *Zeitschrift fur Naturforschung B*, 59b, 1480-1482, (2004).

Ahmed A. Mohamed, Lisa M. Perez, and John P. Fackler, Jr., "Unsupported intermolecular argentophilic interaction in the dimer of trinuclear silver(I) 3,5-diphenylpyrazolates." *Inorganica Chimica Acta*, 358, 1657-1662, (2005).

C. W. Liu, Michael D. Irwin, Ahmed A. Mohamed, and John P. Fackler Jr., "Cluster self-assembly of centered cubes of copper(I) with dialkyldithiophosphate ligands. X-ray structures of $[\text{Cu}_8(\text{DDP})_6(\mu_8\text{-X})]\text{PF}_6$ ($\text{DDP}=\text{S}_2\text{P}(\text{O}^i\text{Pr})_2$; $\text{X}=\text{Cl}$ or Br) and their relationship to oxide and sulfide centered zinc(II) dialkyldithiophosphates, $[\text{Zn}_4(\text{DDP})_6(\mu_8\text{-S or O})]$." *Inorganica Chimica Acta*, 357, 3950-3956, (2004).

- B. Refereed "In Press" Articles. (Articles reported in this section are refereed articles that are either in press, submitted, or accepted for publication. These articles should acknowledge Welch Foundation support, have not previously been reported to the Foundation, and should be reported in Section A. above in the grant year they appear in print. Copies of these articles should only be sent when listed in Section A.)

Ahmed A. Mohamed, Manal A. Rawashdeh-Omary, Mohammad A. Omary, John P. Fackler Jr., External heavy-atom effect of gold in a supramolecular acid-base pi stack., Dalton, In Press (2005).

Mohammad A. Omary, Ahmed A. Mohamed, Manal A. Rawashdeh-Omary, John P. Fackler, Jr., "Photophysics of Electron-rich Trinuclear Au(I) Complexes with Organic Electrophiles in Stacked Lattices." *Coordination Chemistry Reviews*, In Press (2005).

4. OTHER PUBLISHED ARTICLES OR PATENTS. (Conference or Symposium Proceedings, Books, Other Invited Articles with Original Material, or Patent Applications filed on any inventions made with the assistance of The Welch Foundation. Articles listed in this section must have appeared in print, have acknowledged Welch Foundation support, and have not previously been reported to the Foundation.)

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Investigator (Signature)

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