Synthesis and Characterization of New Low-Dimensional Metal Complex Conductors

William E. Hatfield

Department of Chemistry
CB #3290, Venable Hall
University of North Carolina at Chapel Hill
Chapel Hill, NC 27599-3290

Office of Naval Research
Chemistry Division
800 North Quincy Street
Arlington, VA 22217-5000

Final report which contains a recapitulation of accomplishments and conclusions. A listing of all technical reports and journal articles emanating from the grant is included along with the names of all personnel who participated in the research.
SYNTHESIS AND CHARACTERIZATION OF NEW LOW-DIMENSIONAL
TRANSITION METAL COMPLEX CONDUCTORS

BY
WILLIAM E. HATFIELD
UNIVERSITY OF NORTH CAROLINA
DEPARTMENT OF CHEMISTRY
CHAPEL HILL, NORTH CAROLINA 27599-3290

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**Official Certification**

I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

**Signature of Author:**

Scott Blackwood  
Contracts and Grants
FINAL REPORT

1. Summary: This research program was devoted to the designed synthesis and characterization of new transition metal complex conductors. Also, in keeping with good scientific practice, unusual fundamental observations discovered during the course of the research were given attention as discussed in End of the Year Reports, Technical Reports, and orally. The design of the new compounds was based on sound scientific principles developed in our laboratory and in other laboratories around the world. The new compounds were characterized by temperature-dependent AC and DC electrical conductivity measurements, magnetic susceptibility and electron paramagnetic resonance, structural determinations by single-crystal X-ray diffraction, and by other spectroscopic techniques, as appropriate. The results of the research contributed significantly to practical and fundamental knowledge, provided educational opportunities for a number of undergraduate students, graduate students, and research associates. The work attracted attention of the scientific and technical community and stimulated activities in laboratories around the world (see the list of authors in the publications cited below). Brief reviews of important results are present in the following paragraphs.

Bis-Macrocyclic-Lanthanide Compounds: Many of the compounds studied were mixed-valence or non-stoichiometric and exhibited high and anisotropic electrical conductivities. Remarkable fundamental results include the discovery of strong exchange coupling between the lanthanide ions and the ligand radicals. Previously, it was contended that f-electrons are highly shielded and are essentially unaffected by the nature of the ligands. This entire line of reasoning will have to be re-examined. Also, it was found that some of these compounds have large magnetic moments, even though they did not have unpaired electrons. These are the first compounds found to exhibit such properties. (See technical report no. 45).

Since these compounds are electrochromic, there has been much technical and fundamental work aimed toward their use in devices. Through other support we have made polymeric thin-film layers on appropriate substrates and have made sandwiches on the polymers. The work is in preliminary stages and will form the basis for an honors research project in the coming year.

New Materials with High Dielectric Properties: Polymeric materials most frequently have low dielectric constants, and blends are usually compounded to enhance dielectric properties. There are significant problems with these substances, and we have launched a program designed to produce processable polymers with high dielectric constants. This program was described in the 1993 End of the Year Report, where scientific details may be found. The program has attracted the attention of industrial concerns who have the capability of commercializing useful materials that will be produced.
2. Technical Reports Resulting from the Grant:


3. Journal Articles Acknowledging That the Research Was Partially Supported by the Office of Naval Research:


Oki, A. R.; Zhang, H.; Maguire, J. A.; Hosmane, N. S.; Ro, H.-K.; Hatfield, W. E.; Moscherosch, M.; Kaim, W. "Chemistry of C-Terminylsilyl-Substituted Heterocarboranes. 10. Syntheses, Structures and Properties of Anionic Cr(III) and Neutral Cr(IV) Sandwiched Metallacarborane Complexes (1,1'-commpo-Cr[2-(SiMe$_3$)$_3$-3-(R)-2,3-C$_2$B$_4$H$_4$]$_2$) and 1,1'-commpo-Cr[2,3-(SiMe$_3$)$_2$-2,3-C$_2$B$_4$H$_4$]$_2$ (R = SiMe$_3$, Me and H)" Organometallics, 1992, 11, 4202-4213.


4. **Personnel Who Participated in the Research:**

William E. Hatfield
Hye-Keong Ro
Ian Magder
Rachael N. Austin
Seddick Bocida
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Abstract Distribution List

Professor O. T. Beachley, Jr.
Department of Chemistry
State University of New York
Buffalo, NY 14214

Dr. Alan Berry
Chemistry Division, Code 6120
Naval Research Laboratory
4555 Overlook Ave., SW
Washington, DC 20375-5000

Professor Jerald S. Bradshaw
Department of Chemistry
Brigham Young University
Provo, UT 84602

Professor Ronald Breslow
Department of Chemistry
Columbia University
New York, NY 10027

Dr. Duncan W. Brown
Advanced Technology Materials, Inc.
520-B Danbury Rd.
New Milford, CT 06776

Professor Herbert C. Brown
Purdue University
Department of Chemistry
West Lafayette, IN 47907

Professor Steven L. Buchwald
Department of Chemistry
Massachusetts Institute of Technology
Cambridge, MA 02139

Professor Cynthia J. Burrows
Department of Chemistry
State University of New York
Stony Brook, NY 11794-3400

Dr. Roque J. Calvo
Executive Secretary
The Electrochemical Society
10 South Main St.
Pennington, NJ 08534-2896

Professor Peter Chen
Department of Chemistry
Harvard University
Cambridge, MA 02138

Professor N. John Cooper
Department of Chemistry
University of Pittsburgh
Pittsburgh, PA 15260

Professor Anthony W. Czarnik
Department of Chemistry
Ohio State University
120 West 18th Ave.
Columbus, OH 43210-1173

Professor Peter Dervan
Department of Chemistry
California Institute of Technology
Pasadena, CA 91125

Professor Francois N. Diederich
Department of Chemistry
University of California
405 Hilgard Ave.
Los Angeles, CA 90024

Professor Dennis A. Dougherty
Department of Chemistry
California Institute of Technology
Pasadena, CA 91125

Professor Kenneth M. Doxsee
Department of Chemistry
University of Oregon
Eugene, OR 97403

Dr. Regis J. Ebner, Jr.
Director of Finance
Materials Research Society
9800 McKnight Rd., Ste. #27
Pittsburgh, PA 15237

Professor Margaret C. Etter
Department of Chemistry
University of Minnesota
207 Pleasant St., S.E.
Minneapolis, MN 55455

Professor Wilmer K. Fife
Department of Chemistry
Indiana University-Purdue University at Indianapolis
1125 East 38th St.
PO Box 647
Indianapolis, IN 46223

Professor Samuel H. Gellman
Department of Chemistry
1101 University Ave.
Madison, WI 53706

Professor Andrew D. Hamilton
Department of Chemistry
University of Pittsburgh
Pittsburgh, PA 15260

Professor William E. Hatfield
Department of Chemistry
University of North Carolina
Chapel Hill, NC 27514

Dr. Kelvin Higa
Chemistry Division
Research Department
Naval Weapons Center
China Lake, CA 93555

Professor Kenneth D. Karlin
Merry Hall 146
The Johns University
34th & Charles Streets
Baltimore, MD 21218

Professor Arthur E. Martell
Department of Chemistry
Texas A&M University
College Station, TX 77843-3255

Professor Thomas J. McCarthy
Department of Polymer Science
University of Massachusetts
Rm. 701 Graduate Research Center
Amherst, MA 01003

Dr. Stephen W. McElvany
Code 6113, Chemistry Division
Naval Research Laboratory
Washington, DC 20375-5000

Professor Lisa McElwee-White
Department of Chemistry
The Leland Stanford Junior University
Stanford, CA 94305

Dr. Theodore G. Pavlopoulos
Naval Ocean Systems Center
Code 521 (B-111)
San Diego, CA 92152-5000

Professor William S. Rees, Jr.
Chemistry Division
The Florida State University
Tallahassee, FL 32306-3006

Professor Peter Schultz
Department of Chemistry
University of California
Berkeley, CA 94720

Dr. Alok Singh
Center for Bio/Molecular Science
Engineering
Department of the Navy
Naval Research Laboratory, Code 6090
Washington, DC 20375-5000

Dr. Michael L. Sinnott
University of Bristol
School of Chemistry
Cantock’s Close
Bristol
ENGLAND BS8 1TS

Dr. Timothy M. Swager
Department of Chemistry
University of Pennsylvania
Philadelphia, PA 19104-6523

Professor Richard L. Wells
Department of Chemistry
Duke University
Durham, NC 27706

Professor Jeffrey D. Winlker
Department of Chemistry
The University of Pennsylvania
133 South 36th St.
Philadelphia, PA 19104-3246

Professor Jeffrey D. Zubkowski
Department of Chemistry
Jackson State University
PO Box 17910, 1400 Lynch St.
Jackson, MS 39217