

This article was downloaded by:

On: 29 January 2011

Access details: *Access Details: Free Access*

Publisher *Taylor & Francis*

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Phosphorus, Sulfur, and Silicon and the Related Elements

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713618290>

Synthesis and Characterization of the First Hybrid Borazine-Phosphazene Ring

Derek P. Gates^a; Ralf Ziembski^a; Arnold L. Rheingold^b; Ian Manners^a

^a Department of Chemistry, University of Toronto, Toronto, Ontario, Canada ^b Department of Chemistry and Biochemistry, University of Delaware, Newark, DE, USA

To cite this Article Gates, Derek P. , Ziembski, Ralf , Rheingold, Arnold L. and Manners, Ian(1994) 'Synthesis and Characterization of the First Hybrid Borazine-Phosphazene Ring', *Phosphorus, Sulfur, and Silicon and the Related Elements*, 93: 1, 421 — 422

To link to this Article: DOI: 10.1080/10426509408021884

URL: <http://dx.doi.org/10.1080/10426509408021884>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.informaworld.com/terms-and-conditions-of-access.pdf>

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

SYNTHESIS AND CHARACTERIZATION OF THE FIRST HYBRID BORAZINE-PHOSPHAZENE RING

**DEREK P. GATES^a, RALF ZIEMBINSKI^a,
ARNOLD L. RHEINGOLD^b, AND IAN MANNERS^{a*}**

**a) Department of Chemistry, University of Toronto, 80 St. George St.,
Toronto M5S 1A1, Ontario, Canada. b) Department of Chemistry and
Biochemistry, University of Delaware, Newark, DE 19716, USA.**

Abstract Whereas borazines and phosphazenes represent two of the most well studied classes of inorganic heterocycles, very few examples of rings constructed of boron, phosphorus and nitrogen are known. This work presents our investigation of these interesting heterocycles.

INTRODUCTION

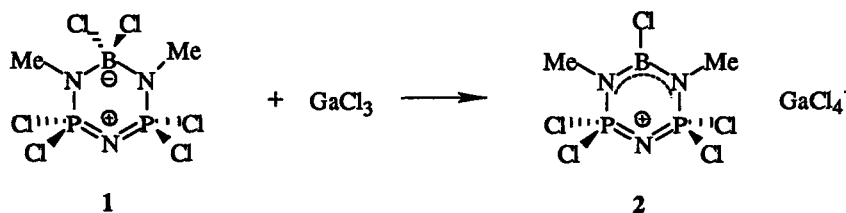
Cyclic heterophosphazenes have attracted considerable attention because of their intrinsically interesting structural features and as potential precursors to new polymer systems via ring-opening polymerization. In particular, species containing transition metals (molybdenum and tungsten) or main group elements (carbon, sulfur(IV) or sulfur(VI)) thermally polymerize to yield novel classes of inorganic polymers.

BORATOPHOSPHAZENES

The boratophosphazene **1** (a zwitterionic species) represents one of the best characterized boron-nitrogen-phosphorus rings and has been prepared by several routes.¹ Electrical conductivity measurements have provided evidence for the formation of an ion pair via chloride loss from boron in polar solvents such as nitrobenzene.² In order to clarify the nature of **1**, a single crystal X-ray diffraction study of this species was undertaken. The BP₂N₃ ring shows a significant deviation from planarity with the boron atom deviating from the best plane by 0.39(1) Å, and the axial B-Cl bond is highly elongated.

Preliminary studies of the thermal ring-opening polymerization behaviour of **1** at 260°C have shown that the classical polyphosphazene $[\text{NPCl}_2]_n$ is formed along with the borazine $[\text{MeBNCl}]_3$, $\text{N}_4\text{P}_4\text{Cl}_8$, and MeCl together with other products.

BORAZINE-PHOSPHAZENE HYBRIDS



Compound **2** was prepared via Lewis acid halide abstraction from **1**. The crystal structure of **2**, shows a planar ring, in which the B-N bond lengths (1.43(1) Å) are typical of borazines indicating some π -bonding from donation of the lone pair on N(Me) into the empty 2p orbital on boron. This represents the first crystallographically characterized example of a borazine-phosphazene hybrid.³ Compound **2** has also exhibited some interesting chemistry, reacting at the boron center with tertiary amines.

ACKNOWLEDGMENTS

We thank the Natural Sciences and Engineering Research Council of Canada (NSERC) for support.

REFERENCES

1. H. Binder, *Z. Naturforsch.*, **26b**, 616 (1971); H. Binder, and J. Palmtag, *Z. Naturforsch.*, **34b**, 179 (1979); F. G. Sherif, and C. D. Schmulbach, *Inorg. Chem.*, **5**, 322 (1966).
2. H. Becke-Goehring, and H. J. Müller, *Z. Anorg. Allg. Chem.*, **362**, 51 (1968).
3. D. P. Gates, R. Ziembinski, A. L. Rheingold, B. S. Haggerty, and I. Manners, *Angew. Chem.*, in press.