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Final Report

During the course of this contract, two very significant advances in our understanding of the formation of bonds between group 13 and group 15 elements have been achieved. (1) The substituents bonded to the group 13 element can have a dramatic effect on the ease of the elimination reaction with group 15 bases having acidic protons. Our experiments demonstrated that $Me_2Ga(C_5H_5)$ reacts with $P(H)Ph_2$ at -78°C to form $[Me_2GaPPh_2]_2$, whereas

$$Me_2Ga(C_5H_5) + P(H)Ph_2 \xrightarrow{-78°C} \tfrac{1}{2}(Me_2GaPPh_2)_2 + C_5H_6$$

$GaMe_3$ requires temperatures of 160°C to form the identical gallium-phosphorus product. (2) Indium(I) compounds react with elemental phosphorus (P_4) at the remarkedly low temperature of 175°C to form InP. Both of these

$$In(C_5H_5) + 1/4\ P_4 \xrightarrow{175°C} InP_{(s)} + \tfrac{1}{2}(C_5H_5)_2$$

scientific advances have provided the bases for applications for United States patents and have provided the background necessary to develop new precursors for deposition of group 13-15 materials, hopefully of electronic quality.

A second fundamental aspect of this research has been the preparation and complete characterization of a variety of new compounds. The new compounds include $[(Me_3CCH_2)_2InPPh_2]_3$, $[(Me_3CCH_2)_2GaPPh_2]_2$, $[(Me_3CCH_2)_2InCH_2PPh_2]_2$, $[(Me_3CCH_2)_2GaCH_2PPh_2]_2$, $[Me_2GaPPhMe]_3$, $[Me_2GaN(H)(C_6H_{12})]_2$, $[(Me_3CCH_2)(Cl)GaPPh_2]_3$, $[(Me_3CCH_2)(Cl)InPPh_2]_3$, $[(Me_3CCH_2)Ga(PPh_2)_2]_2$, $In(C_5Me_5)$, $In(C_5H_4Me)$, $In(C_5H_4CMe_3)$, $In(C_5H_4SiMe_3)$, $In(C_5H_4GeMe_3)$ and $(Me_3CCH_2)_3Ga{\bullet}P(H)Ph_2$. These compounds have enabled us to begin to understand the chemistry of compounds with bonds between group 13 and 15 elements. However, many questions remain to be answered. Without doubt, this basic research is enabling us to predict, prepare and then utilize new precursors for the formation of group 13-15 materials.

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