Group 13 Organometallic Pnicogen Compounds

Preparing molecular organometallic pnicogen compounds of group 13 metals has been and is still closely related to the requirement of semiconducting materials such as GaAs or InP, which possess well defined electrical and optoelectrical properties.
A well established process obtaining thin films of these compounds is the MOCVD (Metal Organic Chemical Vapor Deposition). The fundamental way for this process is to react a metal trialkyl species R_3M and a group 15 hydride EH_3 on a carrier surface and deposit thin ME layers:

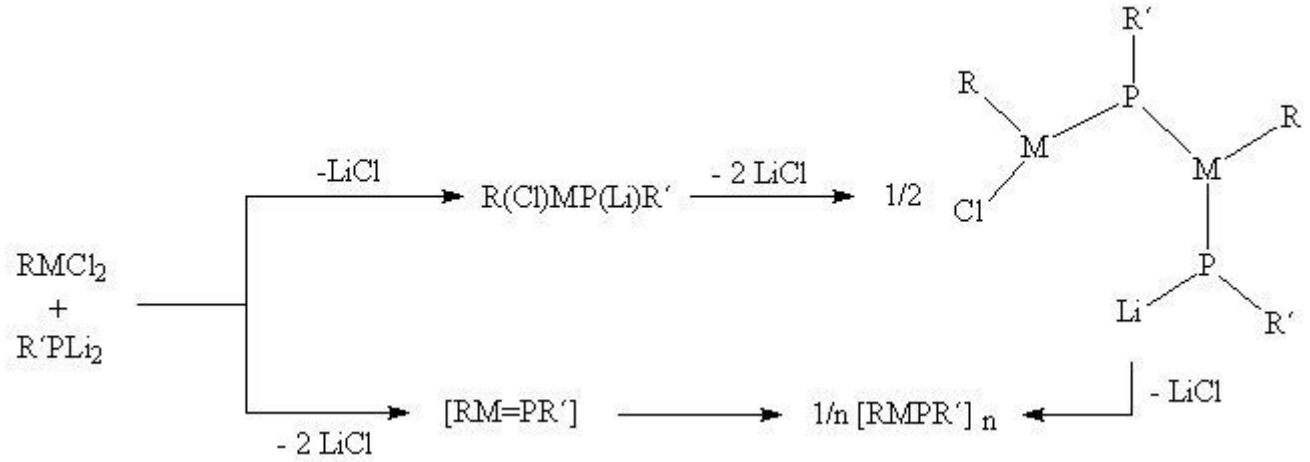
(1) $R_3M + EH_3 \rightarrow ME + 3\,RH$

However, it may be an advantage to use compounds - so called single source precursors -, in which the essential information, namely the chemical bonding of the group 13 metal to the group 15 element, is preformed.
General synthetic route to organometallic 13/15 compounds are transmetallation reactions. As shown in scheme 2 the simplest reaction efforts an 1:1 (M:E) complex:

(2) $n\,R_2MCl + n\,LiER'_2 \rightarrow [R_2MER'_2]_n + n\,LiCl.$

Depending on the sterical demandings of the ligands R and R´ the formal monomers $R_2MER'_2$ undergo oligomerization leading to molecules containing four- or six-membered $(ME)_n$-rings (see figures 1 and 2). Especially NMR investigations gain deep insight into the nature of the core and the variable position and geometry of the exocyclic carbon ligands.

A demanding synthetic challenge is the preparation of compounds with formal triple bond between M and E, [RMER´]:



(3)

Scheme 3 shows possible pathways to these substrates and indicates the competition between a ring-closure and a polycondensation reaction, the former being favoured by the well-known dilution principle. The basic structural motif in such organometallic pnicogenides is a $(ME)_4$ heterocubane cage shielded by exocyclic carbon ligands (figure 3).

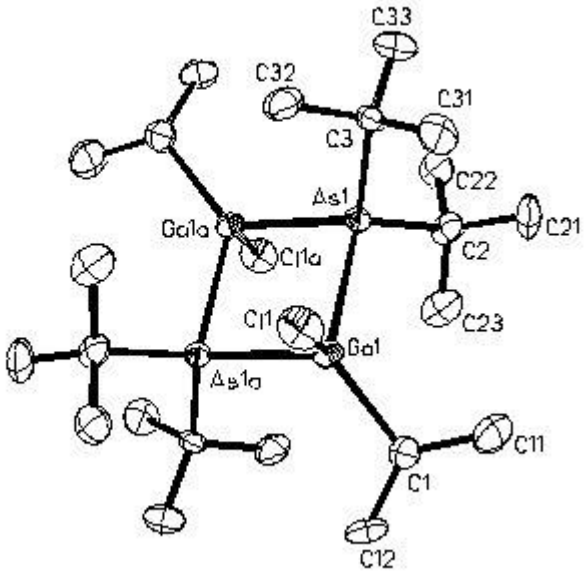


figure 1

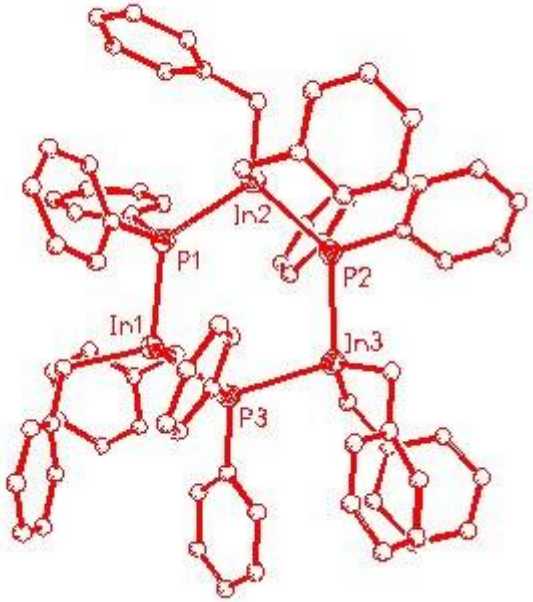


figure 2

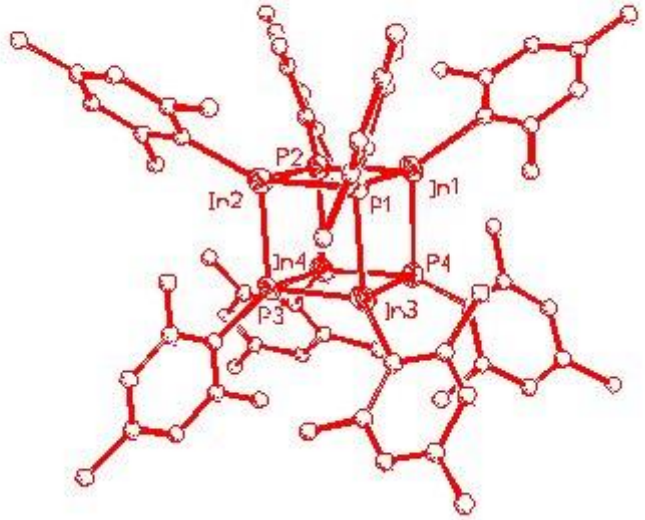


figure 3

Literature:

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