Synthesis and Characterization of an Air-Stable Gallium Hydride, [t-Bu(H)Ga(μ-NEt$_2$)]$_2$, and Related Chloride Derivatives


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Abstract

The synthesis of [t-Bu(H)Ga(μ-NEt$_2$)]$_2$ (1) was accomplished by the addition of 4 t-BuLi to [Cl$_2$Ga(μ-NEt$_2$)]$_2$. Evidence suggests that two tert-butyl groups are lost as isobutylene and result in Ga-H bond formation. The gallium hydride 1 is remarkably stable towards ambient air, oxygen, photolysis, and moderate heating, however in CHCl$_3$ the hydride is replaced by chloride, producing [t-Bu(Cl)Ga(μ-NEt$_2$)]$_2$ (2). Compound 1 may also be synthesized by sequential tert-butyl additions to [Cl$_2$Ga(μ-NEt$_2$)]$_2$. A singly substituted tert-butyl dimer, t-Bu(Cl)Ga(μ-NEt$_2$)$_2$GaCl$_2$ (3), was also isolated and interconversions between 1, 2 and 3 are described. Compound 1 was tested for utility in the chemical vapor deposition of GaN and produced gallium-rich films at low temperatures (< 250 ºC) with limited nitrogen incorporation due to facile Et$_2$NH elimination.

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[\text{Cl}_2\text{Ga}(\mu-\text{NEt}_2)]_2 + 4 \text{ t-BuLi} \rightarrow [\text{t-Bu(H)Ga}(\mu-\text{NEt}_2)]_2 (1) + 2 (\text{CH}_3)_2\text{CCH}_2 + 4 \text{ LiCl}
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