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Trimethylaluminum amide formation

Trimethylaluminum is a valuable reagent in organic synthesis due to its role both as a Lewis acid and a methyl anion equivalent. ¹ However, because of its pyrophoric nature, it cannot be easily handled in most laboratory settings. Developed by the Woodward group (University of Nottingham, U.K.), DABAL-Me3 is an adduct of trimethylaluminum and DABCO® that is a free-flowing solid that can be manipulated without the need for an inert atmosphere. ¹ The reagent has a hydrolytic stability comparable to LiBH4, as it is moisture sensitive but can be weighed out easily on the bench and stored in standard glassware. The reagent has been employed in numerous reactions including methylations of aldehydes and imines, ^{1,2} the methylation of aryl and vinyl halides, ³ conjugate additions to enones, ⁴ and amide-bond formation. ⁵ In the presence of the appropriate chiral catalyst, some of these transformations can be performed enantioselectively. Figure 1. ¹ ² ³ ⁴ ⁵ DABAL-Me3 Non-pyrophoric Excellent handling characteristics; solid can be handled briefly in non-humid air Useful methyl anion equivalent in numerous reaction paradigms DABAL-Me3 serves as a methyl anion source in nickel-catalyzed asymmetric additions of organoaluminum reagents to aldehydes. Electron-rich benzaldehyde derivatives give the highest enantioselectivities in this reaction. In certain cases, this method provides access to non-racemic chiral secondary alcohols not accessible through Noyori-type asymmetric transfer hydrogenation (e.g. 1-cyclohexylethanol). ^{2,6} Figure 2. Nickel-Catalyzed Addition to Aldehydes DABAL-Me3 is a powerful methyl anion source in the Pd-catalyzed methylation of aryl and vinyl halides. ¹ ² ³ ⁴ ⁵ ⁶ ⁷ ⁸ ⁹ ¹⁰ ¹¹ ¹² ¹³ ¹⁴ ¹⁵ ¹⁶ ¹⁷ ¹⁸ ¹⁹ ²⁰ ²¹ ²² ²³ ²⁴ ²⁵ ²⁶ ²⁷ ²⁸ ²⁹ ³⁰ ³¹ ³² ³³ ³⁴ ³⁵ ³⁶ ³⁷ ³⁸ ³⁹ ⁴⁰ ⁴¹ ⁴² ⁴³ ⁴⁴ ⁴⁵ ⁴⁶ ⁴⁷ ⁴⁸ ⁴⁹ ⁵⁰ ⁵¹ ⁵² ⁵³ ⁵⁴ ⁵⁵ ⁵⁶ ⁵⁷ ⁵⁸ ⁵⁹ ⁶⁰ ⁶¹ ⁶² ⁶³ ⁶⁴ ⁶⁵ ⁶⁶ ⁶⁷ ⁶⁸ ⁶⁹ ⁷⁰ ⁷¹ ⁷² ⁷³ ⁷⁴ ⁷⁵ ⁷⁶ ⁷⁷ ⁷⁸ ⁷⁹ ⁸⁰ ⁸¹ ⁸² ⁸³ ⁸⁴ ⁸⁵ ⁸⁶ ⁸⁷ ⁸⁸ ⁸⁹ ⁹⁰ ⁹¹ ⁹² ⁹³ ⁹⁴ ⁹⁵ ⁹⁶ ⁹⁷ ⁹⁸ ⁹⁹ ¹⁰⁰ ¹⁰¹ ¹⁰² ¹⁰³ ¹⁰⁴ ¹⁰⁵ ¹⁰⁶ ¹⁰⁷ ¹⁰⁸ ¹⁰⁹ ¹¹⁰ ¹¹¹ ¹¹² ¹¹³ ¹¹⁴ ¹¹⁵ ¹¹⁶ ¹¹⁷ ¹¹⁸ ¹¹⁹ ¹²⁰ ¹²¹ ¹²² ¹²³ ¹²⁴ ¹²⁵ ¹²⁶ ¹²⁷ ¹²⁸ ¹²⁹ ¹³⁰ ¹³¹ ¹³² ¹³³ ¹³⁴ ¹³⁵ ¹³⁶ ¹³⁷ ¹³⁸ ¹³⁹ ¹⁴⁰ ¹⁴¹ ¹⁴² ¹⁴³ ¹⁴⁴ ¹⁴⁵ ¹⁴⁶ ¹⁴⁷ ¹⁴⁸ ¹⁴⁹ ¹⁵⁰ ¹⁵¹ ¹⁵² ¹⁵³ ¹⁵⁴ ¹⁵⁵ ¹⁵⁶ ¹⁵⁷ ¹⁵⁸ ¹⁵⁹ ¹⁶⁰ ¹⁶¹ ¹⁶² ¹⁶³ ¹⁶⁴ ¹⁶⁵ ¹⁶⁶ ¹⁶⁷ ¹⁶⁸ ¹⁶⁹ ¹⁷⁰ ¹⁷¹ ¹⁷² ¹⁷³ ¹⁷⁴ ¹⁷⁵ ¹⁷⁶ ¹⁷⁷ ¹⁷⁸ ¹⁷⁹ ¹⁸⁰ ¹⁸¹ ¹⁸² ¹⁸³ ¹⁸⁴ ¹⁸⁵ ¹⁸⁶ ¹⁸⁷ ¹⁸⁸ ¹⁸⁹ ¹⁹⁰ ¹⁹¹ ¹⁹² ¹⁹³ ¹⁹⁴ ¹⁹⁵ ¹⁹⁶ ¹⁹⁷ ¹⁹⁸ ¹⁹⁹ ²⁰⁰ ²⁰¹ ²⁰² ²⁰³ ²⁰⁴ ²⁰⁵ ²⁰⁶ ²⁰⁷ ²⁰⁸ ²⁰⁹ ²¹⁰ ²¹¹ ²¹² ²¹³ ²¹⁴ ²¹⁵ ²¹⁶ ²¹⁷ ²¹⁸ ²¹⁹ ²²⁰ ²²¹ ²²² ²²³ ²²⁴ ²²⁵ ²²⁶ ²²⁷ ²²⁸ ²²⁹ ²³⁰ ²³¹ ²³² ²³³ ²³⁴ ²³⁵ ²³⁶ ²³⁷ ²³⁸ ²³⁹ ²⁴⁰ ²⁴¹ 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Chem. 52, 2033-2036 (1987).Article Google Scholar Pathak, V. P. Selective formation of pyrrolo[3,2-d]pyrimidines from methyl[(N-benzoyl-S-methylisothiocarbamoyl)amino]-1H-pyrrole-2-carboxylate. Org. Process Res. Dev. 4, 129-130 (2000).Article CAS Google Scholar Huebner, C. F., Lucas, R., MacPhillamy, H. B. & Troxell, H. A. Rauwolfia alkaloids. XIV. Derivatives of yohimbé alkaloids. J. Am. Chem. Soc. 77, 469-472 (1955).Article Google Scholar Theppawong, A., Ploypradith, P., Chuawong, P., Ruchirawat, S. & Montakarn, C. Facile and divergent synthesis of lamellarins and lactam-containing derivatives with improved drug likeness and biological activities. Chem. Asian J. 10, 2631-2650 (2015).Article CAS PubMed Google Scholar Zhao, Q., Dewhurst, R. D., Braunschweig, H. & Chen, X. A new perspective on borane chemistry: the nucleophilicity of the B-H bonding pair electrons. Angew. Chem. Int. Ed. 58, 3268-3278 (2019).Article CAS Google Scholar Chen, X., Zhao, J.-C. & Shore, S. G. The roles of dihydrogen bonds in amine borane chemistry. Acc. Chem. Res. 46, 2666-2675 (2013).Article CAS PubMed Google Scholar Trageser, T., Bolte, M., Lerner, H.-W. & Wagner, M. B-B bond nucleophilicity in a tetraaryl μ -hydridodiborane(4) anion. Angew. Chem. Int. Ed. 59, 7726-7731 (2020).Article CAS Google Scholar Chen, X.-M. et al. Elucidation of the formation mechanisms of the octahydrotriborate anion (B₃H₈⁻) through the nucleophilicity of the B-H bond. J. Am. Chem. Soc. 140, 6718-6726 (2018).Article CAS PubMed Google Scholar Chen, X.-M. et al. Facile synthesis of unsolvated alkali metal octahydrotriborate salts MB₃H₈ (M = K, Rb, and Cs), mechanisms of formation, and the crystal structure of KB₃H₈. Angew. Chem. Int. Ed. 58, 2720-2724 (2019).Article CAS Google Scholar Li, H. et al. Formation mechanisms, structure, solution behavior, and reactivity of aminodiborane. J. Am. Chem. Soc. 137, 12406-12414 (2015).Article CAS PubMed Google Scholar Hutchins, R. O., Learn, K., El-Telbany, F. & Stercho, Y. P. Aminoborohydrides as reducing agents. 1. Sodium (dimethylamino)- and (tert -butylamino)borohydrides as selective reducing agents. J. Org. Chem. 49, 2348-2443 (1984).Article Google Scholar Pasmansky, L., Singaram, B. & Goralski, C. T. Recent advances in the chemistry of lithium aminoborohydrides. Aldrichim. Acta 38, 61-65 (2005).CAS Google Scholar Xu, W., Fan, H., Wu, G. & Chen, P. Comparative study on reducing aromatic aldehydes by using ammonia borane and lithium amidoborane as reducing reagents. New J. Chem. 36, 1496-1505 (2012).Article CAS Google Scholar Wang, J. et al. Hydroboration reaction and mechanism of carboxylic acids using NaNH₂(BH₃)₂, a hydroboration reagent with reducing capability between NaBH₄ and LiAlH₄. J. Org. Chem. 86, 5305-5316 (2021).Article CAS PubMed Google Scholar Chen, X.-M. et al. Brønsted and Lewis base behavior of sodium amidotrihydridoborate (NaNH₂BH₃). Eur. J. Inorg. Chem. 38, 4541-4545 (2017).Article CAS Google Scholar Chen, X.-M. et al. Controllable syntheses of B/N anionic aminoborane chain complexes by the reaction of NH₃BH₃ with NaH and the mechanistic study. Dalton. Trans. 48, 14984-14988 (2019).Article CAS PubMed Google Scholar Lefour, J.-M. & Loupy, A. The effect of cations on nucleophilic additions to carbonyl compounds: carbonyl complexation control versus ionic association control. application to the regioselectivity of addition to α -enones. Tetrahedron 34, 2597-2605 (1978).Article CAS Google Scholar Wolstenholme, D. J. et al. Homopolar dihydrogen bonding in alkali-metal amidoboranes and its implications for hydrogen storage. J. Am. Chem. Soc. 133, 16598-16604 (2011).Article CAS PubMed Google Scholar Frisch, M. J. et al. Gaussian 16, Revision A.03, Gaussian, Inc., Wallingford CT, 2016.Zhao, Y. & Truhlar, D. G. The M06 suite of density functionals for main group thermochemistry, thermochemical kinetics, noncovalent interactions, excited states, and transition elements: two new functionals and systematic testing of four M06 functionals and 12. Theor. Chem. Acc. 120, 215-241 (2008).Article CAS Google Scholar Pritchard, B. P., Altarawy, D., Didier, B. T., Gibson, T. D. & Windus, T. L. A new basis set exchange: an open, up-to-date resource for the molecular sciences community. J. Chem. Inf. Model. 56, 4814-4820 (2019).Article CAS Google Scholar Marenich, A. V., Cramer, C. J. & Truhlar, D. G. Universal solvation model based on solute electron density and on a continuum model of the solvent defined by the bulk dielectric constant and atomic surface tensions. J. Phys. Chem. B. 113, 6378-6396 (2009).Article CAS PubMed Google Scholar Page 21CH3THF5 min91%2CH3CH3CN5 min91%3CH3Toluene10 h91%4CH3CH2Cl210 h90%5CH2CH3THF5 min83%6CH2CH2CH3THF5 min83%7iPrTHF5 min91%8tBuTHF5 min88%9PhTHF5 min80%