Tech ID: 13-000

Decaboronate Salts to Induce Hypergolicity

Contact:

Dr. Rick Swatloski
Director - OTT
(205) 348-8583
RPSwatloski@ua.edu

Status:

Seeking R&D and/or licensing partner

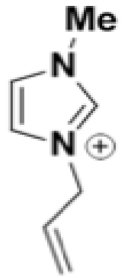
Patent Filed

Inventor:

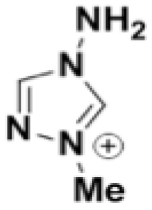
Dr. Robin Rogers
Adjunct Professor
Chemistry
University of Alabama

Decaboronate Salts

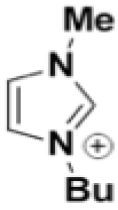
- Decaboronate salts have been found to be hypergolic upon contact with nitric acid, tetrahydrofuran, ethyl acetate, and acetonitrile.
  - Hypergolic components spontaneously ignite when they come into contact with one another.
  - Decaboronate ($[B_{10}H_{13}]^-$) and nonaboronate ($[B_9H_{14}]^-$) salts are hypergolic "trigger" additives to induce hypergolicity
- Synthesized via proton transfer through decaborane.
- The salts can be dissolved into a solution to induce hypergolicity.
- When dissolved in solution the salts will make ANY solvent hypergolic assuming the solution is combustible.



1-allyl-3-methyl-imidazolium (Allyl DCA)



1-methyl-4-amino-1,2,4-triazolium (MAT DCA)



1-butyl-3-methyl-imidazolium (BMIM DCA)

Advantages of Decaboronate Salts

- Decaboronate salts have faster ignition delays (< 3 ms) than current propellant hydrazine (~15 ms)
- Decreased sensitivity to water
- Can be used as a bipropellant or solid fuel.
  - Hydrazine, MMH and UDMH are carcinogenic and hazardous to store
- Nitric Acid is much more benign to store and keep compared with other oxidizer and fuel standards.
- Can be used in RP-1, which currently uses kerosene and liquid oxygen, to replace liquid oxygen as an oxidizer.
  - Liquid oxygen is very inefficient to pressurize cool and store.

Table 1. Decaborane as a "trigger" additive

Ionic Liquid	Molar ratio of IL-Decaborane			
	Neat	1000-1	100-1	10-1
	Ignition delay (ms)			
[BMIM][DCA]	48(4)	58(3)	42(2)	5[a]
[MAT][DCA]	39(2)	69(21)	31(1)	11(4)[b]
[AMIM][DCA]	35(5)	33(4)	30(6)	4(1)

[a]Due to high viscosity of sample only one ignition delay was obtained
[b]Due to high viscosity of sample, the drop test was performed in a watchglass instead of a vial
[c]Values in parenthesis denote standard deviation

For More Information, Click to View YouTube Pitch