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ambient conditions. In this frame, our group has recently provided several examples of carbon materials syntheses but fewer ones in the direction of inorganics, the latter mainly focusing on the action of fuming nitric acid HNO_3 on organometallic precursors, such as metallocenes and metallocene dichlorides. Here special attention is given to the investigation of additional chemical options towards the hypergolic synthesis of inorganic materials with unusual shapes. The proposed alternatives include, but not limited to, (1) the hypergolic ignition of titanium (IV) dimethylamide $Ti[N(CH_3)_2]_4$ by fuming nitric acid HNO_3 towards the formation of titania TiO_2 nanoparticles with twin morphology, (2) the hypergolic ignition of molten iron (III) chloride hexahydrate $FeCl_3{\cdot}6H_2O$ by sodium hydride NaH towards the formation of thin maghemite γ-Fe_2O_3 nanosheets. Worth noting, tin (IV) dimethylamide $Sn[N(CH_3)_2]_4$ reacts similarly to titanium (IV) dimethylamide $Ti[N(CH_3)_2]_4$ with fuming nitric acid HNO_3 to correspondingly afford conductive stannic oxide SnO_2, whereas cobalt (II) chloride hexahydrate $CoCl_2{\cdot}6H_2O$ and copper (II) nitrate hexahydrate $Cu(NO_3)_2{\cdot}6H_2O$ react similarly to iron (III) chloride hexahydrate $FeCl_3{\cdot}6H_2O$ with sodium hydride NaH to correspondingly afford metallic cobalt Co and copper (II) oxide CuO, respectively. Therefore, metal (IV) dimethylamides and low melting point hydrated transition metal salts (chlorides or nitrates) appear as a new and general class of precursors towards the hypergolic synthesis of inorganic materials with interesting morphologies.

Conflict of interest

The author declared that he has no conflicts of interest to this work.

References

1. Bourlinos AB, Chalmpes N, Gournis D, et al. Hypergolic materials synthesis: a review. J Nanotechnol Res 4 (2022): 059-096.
2. Baikousi M, Chalmpes N, Spyrou K, et al. Direct production of carbon nanosheets by self-ignition of pyrophoric lithium dialkylamides in air. Mater Lett 254 (2019): 58-61.
3. Chalmpes N, Spyrou K, Bourlinos AB, et al. Synthesis of highly crystalline graphite from spontaneous ignition of in situ derived acetylene and chlorine at ambient conditions. Molecules 25 (2020): 297.
4. Chalmpes N, Asimakopoulos G, Spyrou K, et al. Functional carbon materials derived through hypergolic reactions at ambient conditions. Nanomaterials 10 (2020): 566.
5. Chalmpes N, Spyrou K, Vasilopoulos KC, et al. Hypergolics in carbon nanomaterials synthesis: new paradigms and perspectives. Molecules 25 (2020): 2207.
6. Chalmpes N, Tantis I, Bakandritsos A, et al. Rapid carbon formation from spontaneous reaction of ferrocene and liquid bromine at ambient conditions. Nanomaterials 10 (2020): 1564.
7. Chalmpes N, Bourlinos AB, Sedajova V, et al. Hypergolic materials synthesis through reaction of fuming nitric acid with certain cyclopentadienyl compounds. C 6 (2020): 61.
8. Chalmpes N, Bourlinos AB, Talande S, et al. Nanocarbon from rocket fuel waste: the case of furfuryl alcohol-fuming nitric acid hypergolic pair. Nanomaterials 11 (2021): 1.
9. Chalmpes N, Moschovas D, Tantis I, et al. Carbon nanostructures derived through hypergolic reaction of conductive polymers with fuming nitric acid at ambient conditions. Molecules 26 (2021): 1595.
10. Chalmpes N, Moschovas D, Bourlinos AB, et al. Hypergolic ignition of 1,3-cyclodienes by fuming nitric acid toward the fast and spontaneous formation of carbon nanosheets at ambient conditions. Micro 1 (2021): 15-27.
11. Chalmpes N, Asimakopoulos G, Baikousi M, et al. Hypergolic synthesis of inorganic materials by the reaction of metallocene dichlorides with fuming nitric acid at ambient conditions: the case of photocatalytic titania Sci 3 (2021): 46.
12. Douvalis AP, Polymeros A, Bakas T. IMSG09: a ^{57}Fe-^{119}Sn Mössbauer spectra computer fitting program with novel interactive user interface. J Phys Conf Ser 217 (2010): 012014.
13. Uttam P, Kumar V, Kim K-H, et al. Nanotwinning: generation, properties, and application. Mater Des 192 (2020): 108752.
14. Liu R, Liu J-F, Zhang L-Q, et al. Low temperature synthesized ultrathin γ-Fe_2O_3 nanosheets show similar adsorption behaviour for As (III) and As(V). J Mater Chem A 4 (2016): 7606-7614.
15. Murad E, Jhonson JH. Iron Oxides and Oxyhydroxides. In Mossbauer Spectroscopy Applied to Inorganic Chemistry. Long GJ Ed Plenum Press: New York, USA II (1987).
16. Morup S. Mössbauer effect in small particles. Hyperfine Interact 60 (1990): 959-973.
17. Cullity BD, Graham, CD. Introduction to Magnetic Materials, Hoboken, New Jersey, John Wiley and Sons (2009).