Poster Presentation

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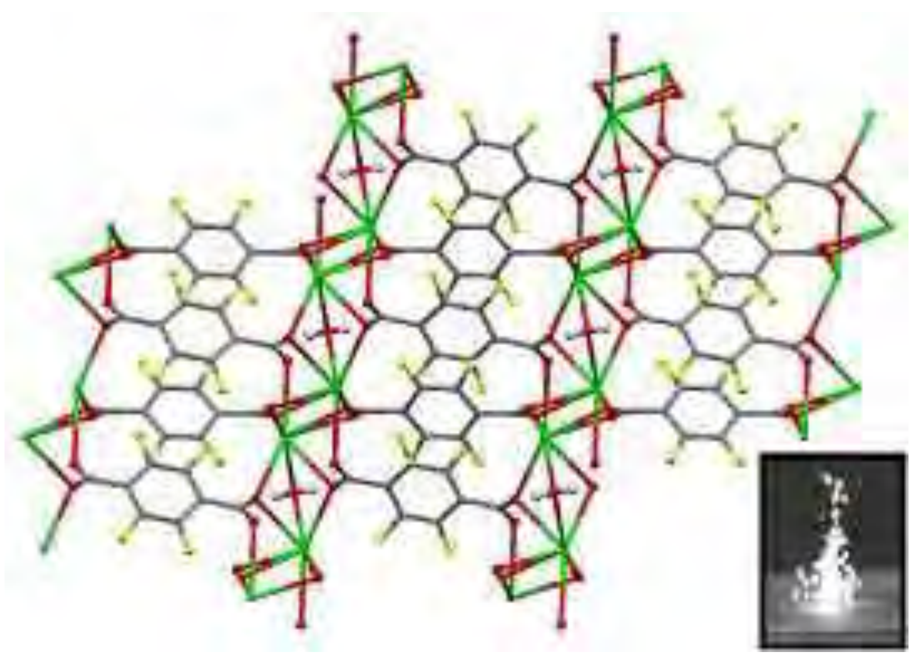
Mixing and Quantifying Multi-Component Materials for Pyrotechnic Applications

L. Blair[1,2], S. Coles[1], I. Sinclair[2], R. Vrcelj[1]
[1]*University of Southampton, Chemistry, Faculty of Natural and Environmental Science, Southampton, UK,* [2]*University of Southampton, Engineering Materials, Faculty of Engineering and the Environment, Southampton, UK*

This multidisciplinary research is looking at the relationship between components of a pyrotechnic product and how manufacturing, in particular the mixing method employed, affects its macroscopic structure and properties. For pyrotechnics to produce the desired effect the ingredients must be intimately mixed, however, the present physical mixing approach can lead to inconsistencies in performance between batches. X-ray computed tomography (CT) was used to investigate the distribution of components in a pyrotechnic mixture. Near-neighbour distances between particles were calculated and used to assess the homogeneity of the mixtures and the efficiency of combustion. Another strand of this research to overcome batch inconsistencies was by chemically binding pyrotechnic ingredients rather than physically mixing them together. One method of achieving this was through incorporating two or more components within the same crystalline lattice. This may be achieved through co-crystallisation or coordination in functional frameworks, thereby reducing the number of components in a physical mixture and minimising the variation between batches. Pang et al. have investigated using MOFs (metal-organic frameworks) to stabilise energetic materials [1]. The research presented here uses MOFs to bring together fuels and oxidisers into one framework to create a MOFirework. Numerous linkers and metal centres were investigated to build up a structural family to correlate structure with pyrotechnic function (e.g. changing burn colour; Sr = red, Ba = green). Both powder and single crystal X-ray diffraction were used to characterise the products. Differential scanning calorimetry was used to look at the thermal profiles to investigate their possible uses as pyrotechnics. Lastly, a burn test was carried out to determine their pyrotechnic effect (e.g. gas, smoke, gas, light, heat, colour, and sound) and quantitatively link this to structure.

[1] *S. Pang, et al, Angew. Chem. Int. Ed., 2013, 52, 14031-14035*



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