The unique intercalation behavior of crystalline carbon nitrides

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Abstract

Polytriazine imide (PTI), one of the only crystalline forms of carbon nitride [1], is a material constructed from triazine (C_3N_3) rings bridged by sp^2 N-H groups, forming stacks of extended layers, analogous to graphite [2]. However, due to the valency difference between carbon and nitrogen the layers contain regularly spaced voids. These voids are a key characteristic feature of these materials. As-synthesised PTI have been shown to contain intercalated HCl [3], LiBr [4] or LiCl [2] in these voids, as a consequence of the synthetic methods used to produce them. We demonstrate a unique method of ion exchange and intercalation for the PTI framework structure. The 'as-synthesised' intercalates are removed first to create a purely carbon nitride framework which is a true crystalline analogue of graphite. The removal of the intercalates to unreported base levels is confirmed by a significant reduction in the gallery height deduced from X-ray diffraction. This PTI framework is shown to have a remarkable ability to accept guest ions into its structure. In this way we have, for the first time, shown the truly reversible, non-destructive, intercalation behavior of PTI.

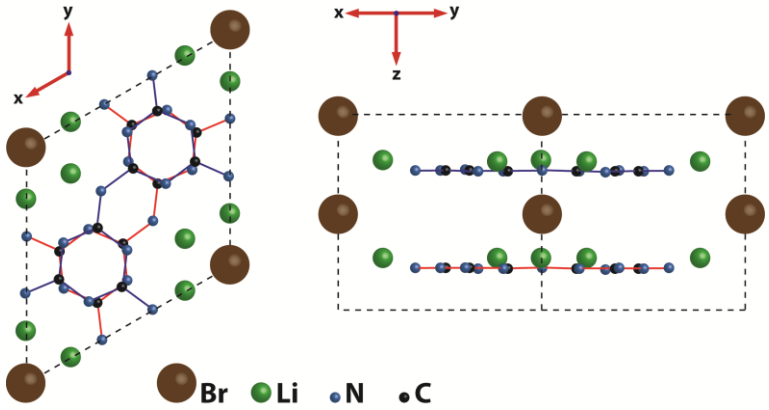

Figure 1. The unit cell of PTI.LiBr showing the planar carbon nitride layers and the positions of the bromine and lithium intercalants

References

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