On the Hydrides of B, C, N, O and F

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I. Introduction: Resonance and the Infinite Hydrides of B & C

I have had thoughts on the hydrides possible for B, C, N, O & F, and particularly for N there seems to be some interesting undiscovered possibilities. Thus I am aware of: (1) the hydrides of B have been investigated & elucidated by Stock et al. and Lipscomb et al. & I have tried to read this literature, but I am not able to get a reliable source, and I understand that the hydrides of B differ from those of C, N, O and F in that they exhibit in some cases exceptions to covalent, electron-pair, 2-center bonds, in the form of electron deficient, 3-center bonds, and that there are innumerable hydrides of B, like the innumerable hydrides of C, which in some cases display resonance effects in their hydroboron structures as suggested by Pauling et al., and (2) the hydrides of C are innumerable and they universally possess Lewis octet, covalent, electron-pair, 2-center bonds, with rare exceptions in which a hydrocarbon has perhaps C atoms in strained geometries which may possess coordination numbers different than 3 or 4, they are successfully described by Pauling's VB theory and Mulliken's MO theory, and some hydrocarbons display classical quantum mechanical resonance effects as predicted by Pauling et al. including the archetypal system benzene.

II. H Delocalization and H-bonding of the Finite Hydrides of N

Next are the finite number of hydrides of N. Thus (3), the hydrides of nitrogen appear to be very few in number, as in 6 distinct structures, in contrast to B and C, and perhaps they are thus: the spectroscopic radical imidogen (NH), the room temperature liquid ammonia, the room temperature liquid hydrazine, the crystalline, non-metallic salt ammonium azide, the spectroscopic species diazene (HN=NH), and perhaps the uncharacterized and intriguing low-temperature condensed phase hydronitrogen, discovered by F.O.Rice in the 1950's, called Rice's blue material with a deep blue (copper sulfate) coloration and the formula (NH).

It is my belief that imidogen (NH) is a spectroscopic oddity that has been characterized as a diatomic radical thus, while ammonia isa Lewis octet species, perhaps comprised of covalent, electron-pair, 2-center bonds, and the molecule can be described by Pauling's VB theory and Mulliken's MO theory, and the same is true of hydrazine, and these two liquids will freeze and give probably polymorphic crystalline patterns with interesting H-bonding possibly. The spectroscopic species diazene is a Lewis octet structure & is unstable, and finally the salt ammonium azide, is the odd hydronitrogen in this family, and is perhaps more than 92% by weight nitrogen, and is an unprecedented hydride in this B, C, N, O and F elemental series, as it forms an ionic crystalline lattice of ammonium cations and azide anions. The structure of at least one polymorph has been determined already, the constituent ions of

ammonium azide are ionic Lewis octet structures and their bonding is accessible by the VB or MO theory descriptions.

Finally there is this weird material called Rice's blue material, it is formed by photolysis or electrolytic discharge dissociation of a stream of ammonia, the products of which are immediately frozen onto a liquid nitrogen cooled copper surface called a cold finger. It is true that the photolysis products are frozen as a deep blue solid material on the cold finger, and that when the surface is warmed to a temperature corresponding to a phase transition of ammonium azide, I believe, the deep blue solid (called Rice's blue material by F.O. Rice) transforms into a white or colorless salt which he has shown is of the ammonium azide structure. Rice concludes that the blue material has the composition (NH) like imidogen or ammonium azide, and it is my belief that Rice has created a low temperature hydronitrogen which is a crystalline lattice of N & H that represents an alternative 3D H-bonded network of N & H, that is a counterpoint to the 3D H-bonded polymorphic crystalline lattices of O & H known as the ordinary ice phases.

I propose thus that this hydronitrogen, known as Rice's blue material, is either an NH rocksalt lattice, or an NH bcc lattice, or an NH cubic diamond lattice, or an NH hexagonal diamond lattice (like ice-I), or an NH cooperite lattice, etc. in which H-bonding is delocalized into 3D, instead of into 2D or 1D like in the other non-metallic hydride structures of O and F. And it is true that the hydrides of N do not exhibit any resonance effects in their bonding, but curiously borazine (inorganic

benzene) displays resonance as a BNH structure. And it is my proposal thus, that these NH crystalline lattices can be accessible possibly at room temperature by cold compression of the non-metallic salt ammonium azide in a diamond anvil cell (DAC). The high pressure synthesis of such crystalline NH lattices may be important for the creation of environmentally benign, high energy chemical propellants for space travel, where oxidation of solid NH thus, with liquid oxygen, would proceed stoichiometrically to generate 2 moles of nitrogen gas and 2 moles of water vapor for every 4 moles of NH fuel and 1 mole of liquid oxygen consumed, as in Equation (1):

$$(1) \quad 4\ NH\ (s) + 1\ O_2\ (l) \rightarrow 2\ H_2O\ (v) + 2\ N_2\ (v)$$

III. Conclusion: Finite Hydrides of O and F & Ice Polymorphs

Thus (4), the hydrides of O appear to be 3 in number including the spectroscopic (OH) radical, room temperature liquid water, and room temperature liquid hydrogen peroxide, the water and hydrogen peroxide molecules are Lewis octet, covalent, electron-pair, two center bond structures which can be described by VB & MO theory.

These molecular structures form 3D crystalline lattices which possess interesting 1D & 2D H-bonded substructures, which have been investigated thoroughly. The hydrides of O possess no resonance properties at all. And finally (5), the hydrides of fluorine are in number one, the (HF) molecule, which is Lewis octet, and which forms liquids with extensive, and perhaps delocalized, 1D & 2D H-bonding. And that is

my interests in the non-metallic hydrides of the 2nd row of the Periodic Table, I don't have any thoughts about berylium dihydride or lithium hydride as they are ordinary ionic salts in perhaps the fluorite structure-type & the rocksalt structure-type, respectively.