

## **Abstract**

The thesis consists of three parts of which Part 1 describes the investigations of borocarbonitrides. In this Part, Section 1.1 provides the synthesis and characterization of different compositions of borocarbonitrides. Section 1.2 shows how BCN can be used to selectively adsorb CO<sub>2</sub> and CH<sub>4</sub>. Composition dependent photoluminescence of borocarbonitrides is discussed in Section 1.3. Section 1.4 presents BCN as a new electrode material in supercapacitors. Few layered borocarbonitrides of different compositions have been used in Li-ion batteries as anode material and Section 1.5 gives a detailed study of this. Section 1.6 presents borocarbonitrides as new Pt-free catalysts for the oxygen reduction reaction (ORR) which is the key reaction at the cathode. In Section 1.7 discusses the extraordinary synergy of BCN-Iron Phthalocyanine composite in the catalytic performance in the ORR. Selective and simultaneous determination of Dopamine and Uric acid by using BCN modified electrode is presented in Section 1.8.

Synthesis and Characterization of Single-walled nanohorns are presented in Part 2. In this section synthesis of single walled nanohorns by using Submerged arc discharge in liquid nitrogen and liquid argon. Charge transfer study of the SWNHs obtained by this method is also presented. Along with this, synthesis and characterization of various other nanocarbons by submerged arc discharge is also presented.

Part 3 discusses about graphene composites and charge transfer study of doped graphene's. In Section 3.1, synthesis and characterization of graphene-cdse composites obtained at liquid interfaces is presented. Finally, Section 3.2 presents the charge transfer studies of B- and N-doped graphene's with electron acceptor (TCNE) and electron donor molecules (TTF).