# CHAPTER I
# INTRODUCTION

As the use of electronic products and communication devices increases, the need of electromagnetic interference (EMI) shielding materials increases as well. In addition, shielding of EMI is of critical use due to health concerns, such as symptoms of languidness, insomnia, headache, etc., on exposure to electromagnetic. Depending upon the shielding efficiency (SE) at different frequency ranges, required conductivity levels are greater than $10^{-2}$ S/m approximately and magnetic permeability is high. Conductive polymer, is new alternative candidate for EMI shielding applications due to its lightweight, high corrosion resistance, ease of synthesis and wide range of conductivity depends on degree of doping. However, conducting materials doesn't have magnetic properties so it can effectively shield electromagnetic waves generated from an electric source, whereas electromagnetic waves from a magnetic source, especially at low frequencies, can be effectively shielded only by magnetic materials. Thus, if composite having both conductive and magnetic components are used as EMI shielding materials, good shielding efficiency can be achieved for various electromagnetic sources.

Among the conductive polymers, polyaniline (PANI) is one of the most promising candidates for industrial application due to its good conductivity, special doping mechanism, and excellent chemical stability (Wenyan Xue *et al.*, 2006). And also magnetite nanoparticles ($Fe_3O_4$) have attracted an increasing interest in the fields of nanoscience and nanotechnology because of the unique and novel physiochemical properties. The properties of $Fe_3O_4$ are unique because it is an oxide with a very high saturated magnetisation and an unusually low bulk resistivity (P. Tarta. *et al.*, 2009). However, both polyaniline and magnetite nanoparticles are not readily processable in non-toxic solvents due to limited solubility and the fact that the materials are normally not melt processable (Wei Pan *et al.*, 2005).

A number of attempts have been done to overcome these limitations. The making of composite is the simplest method with improved processability and mechanical properties while maintaining the inherent properties of the conductive polymer and magnetic material. Various matrixes have been used for incorporating of

PANI and magnetite nanoparticles (Sambhu Bhadra *et al.*, 2009). Typical natural fiber, especially bacterial cellulose (Thawatchai Maneerung *et al.*, 2007), which is produced from metabolism of *Acetobacter xylinum*, has been attracting intensive interest because of their outstanding properties such as high purity absence of lignin or hemicelluloses, completely biodegradable and recyclable a renewable resource, remarkable capacity to hold other components due to high porosity, high wet strength, high tensile strength etc (Dieter Klemm *et al.*, 2001).

The purpose of this work is to prepare bacterial cellulose sheets with electrical and magnetic properties. The electrical properties were provided by using PANI that was synthesized via oxidative polymerization of aniline monomer, using ammonium persulfate (APS) as an oxidizing agent. The magnetic properties were provided by using magnetite particles ($Fe_3O_4$) that were synthesize by co-precipitation method, using ammonia gas as precipitating agent. And bacterial cellulose (BC), which is produced from *Acetobacter xylinum*, was used as matrix to eliminate processibility problem of conductive and magnetic components. The chemical, morphology, electrical and magnetic properties and thermal stability of resultant sheets were characterized by using FT-IR, SEM, a custom-made two-point probe, VSM and TGA respectively. In addition, this work also investigated the effect of humidity on the electrical conductivity and demonstrated the deformation behavior of bacterial cellulose sheets containing PANI under electric field.