CHAPTER I
INTRODUCTION

In the past fifty years, many carbon allotropes, including single and multiwalled carbon nanotubes (SWCNTs and MWCNTs, respectively)[1], spherical buckyballs or fullerenes[2], giant fullerenes[3,4], graphene sheets[5,6], graphene nanoribbons[7], carbon onions and cones[8,9], carbon nanohorn[10] and bud-like aggregates[11], have drawn many research interests[12]. Due to their dimensionality and unique chemical makeup, carbon allotropes exhibit remarkable structural, electronic[13 14 15 16], mechanical[16 17], and optical[18 19] properties. They were developed as materials for many industries, such as microelectronic[20], biosensor[21], polymer composites[22] and solar cells[18].

Usually, the carbon nanoparticles, carbon nanotubes and fullerene, are synthesized by chemical vapor deposition (CVD) but this method usually lefts some trace amounts of catalysts such as nickel, iron and cobalt in the materials[23]. Metal contamination hindered medical applications of the obtained materials. At present, the most widely applied method for synthesis of graphene oxide was developed by Hummers and Offeman[24]. Hummers and Offeman proposed a faster, safer and more effective graphite oxide synthesis. The methods involved strong oxidizing reaction by potassium permanganate in acidic environment. The obtained graphene and graphene oxide can be easily purified from oxidizing agents. In 2009, Wang and co-worker[7] used Hummers method and ultrasonication in 70% nitric acid to prepared three different carbon compounds, fullerene-like nanoparticles, carbon nanotubes and carbon nanoribbons (long ribbon-like graphene oxide). The three products could be isolated by ultracentrifugation. In 2010, Higginbotham and co-worker[25] improved Hummers method by modified various factors, including, solvent, reaction time, reaction temperature and oxidizing agent. The products from the reactions were consisted of various forms of oxidation nanoparticles, for instance, single wall-carbon nanotubes (SWCNT), multi wall-carbon nanotubes (MWCNT), monolayer nanoribbons and multiple layer graphene oxide sheets. The products were partially purified by PTFE membrane filtration. The synthesis methods play an important role in the formation and organization of various carbon nanomaterial architectures. Therefore, this research proposes an effective and quick method to prepare novel architecture of carbon oxide material. The method was modified from the Hummer method[24]. The products were separated by series of centrifugations. The newly proposed carbon oxide nanostructures was characterized.

According to the functional groups of oxidized carbon-based materials (e.g., hydroxyl, epoxide and carbonyl groups) are active to widely reactions. These groups enable carbon-based materials to be functionalized through covalent and non-covalent approaches[26 27]. Moreover, π -conjugated structure of carbon-based materials exhibited ability to absorb hydrophobic molecules, drugs, biomolecules and fluorescent molecules[28]. Recently, many biomedical aspects, for examples, cytotoxicity[29 30 31], biocompatibility[21], surface modification[32 33 34], and ability to deliver bioactive compounds[35 36], of these various carbon-based materials were intensively studied. So this work demonstrated the newly proposed carbon oxide nanostructures which has amphiphilic surface. Existences of reactive functionalities on the surface are ready for further modification and its bio-application. The newly obtained particles were used as nanocarriers for the delivery of active ingredients including curcumin and peptide nucleic acid (PNA) into mammalian cells.